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MACHINERY

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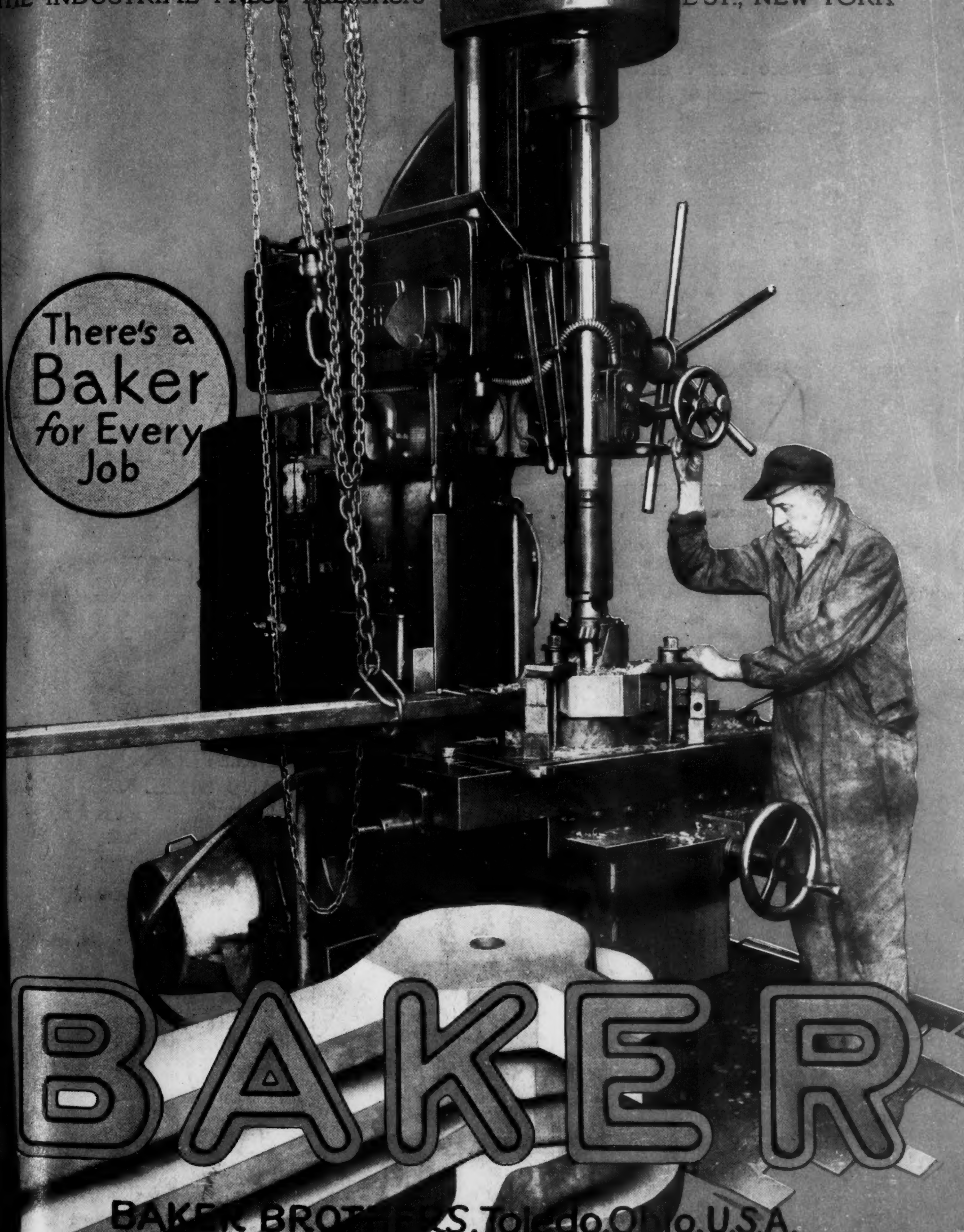

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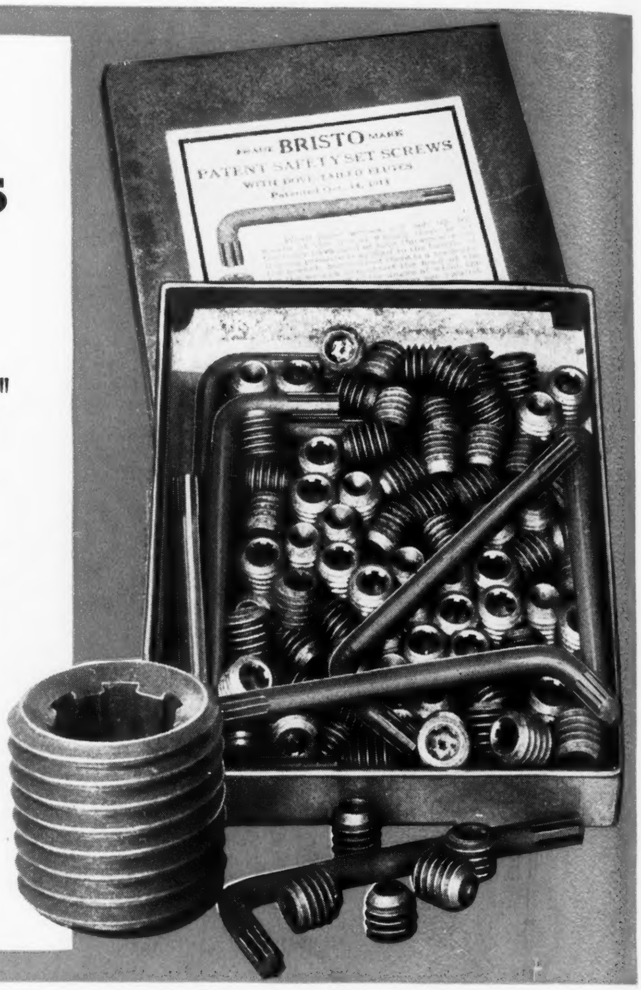

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Recent developments in automobile wheel manufacture are dealt with in the leading article in June MACHINERY. The new wheels are made of pressed steel, and the rims, spokes, and hubs are electrically welded.

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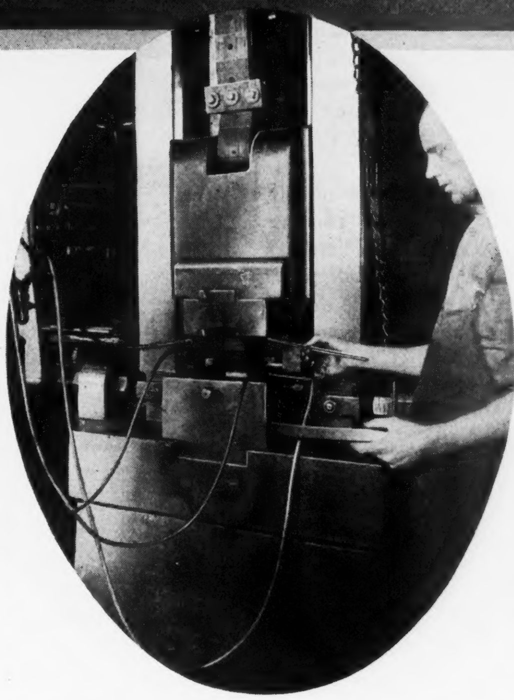
Prolonging the Life of Forging Dies



A Method of Increasing the Resistance of Steel to Repeated Shocks and Resulting Fatigue and Crystallization

By MORGAN PARKER
President, Bard-Parker Co., Inc., New York

A SIMPLE but effective method of prolonging the life of shock-resisting tools has been discovered. This method, briefly described, consists in artificially maintaining the dies or tools, while in use, at a temperature above that resulting from normal operation but below the temperature at which they are hardened and drawn.

When forging dies are expensive to replace, as when exceptional accuracy or intricate shapes are required, the total production obtained during the life of a set of dies becomes an important item in the cost, and the heated die method is especially applicable under these conditions. This method was discovered by H. Reinhardt, 80 Rutland Road, Brooklyn, N. Y., and it was first applied in a commercial way by the Bard-Parker Co., 37 E. 28th St., New York City.

Many efforts have been made in the past to increase the total production obtained during the life of drop-forging dies. These attempts have consisted chiefly in experiments with the better grades of alloy steels in place of ordinary straight carbon and heat-treated die-blocks. Such attempts have generally proved unsuccessful, because the alloy steels, either through lack of toughness or because of an unsuitable composition for hot-forging die work, usually failed, and the cost of most of the new steels proved so high as to more than offset any economy gained through a slight extra service. Attempts to solve the problem by inserting special steel sections in ordinary die-blocks have also resulted in failure in nearly every case.

Prior to the time when high-speed steel first made its appearance, around 1900, there was little reason, perhaps, to question the use of dies and tools at atmospheric or shop temperatures, although even then the practice of warming drop-hammer dies and other shock tools on a cold morning "to take the chill out of them" was quite an old one on two continents. It was known that hardened dies and tools are very brittle around and below the freezing point. Owing to the relatively low critical point of the ordinary carbon steels then in use, care had to be taken not to overheat the faces of the dies while in use and thus impair their hardness; hence it is not surprising that the plan of operating dies or tools at artificially high temperatures was not thought of.

A remarkable discovery has been made regarding a method of prolonging the life of cold-forging dies or other tools that are subject to fatigue and failure as the result of repeated shocks. This discovery, as successfully applied to commercial forging operations, is here described for the first time. Before the introduction of this method in connection with a certain cold-forging operation, the Bard-Parker Co. obtained from a few hundred to about one thousand forgings during the life of an expensive pair of dies. Now by the application of the simple discovery referred to, the production during the life of a set of dies has been increased to fifteen or eighteen thousand forgings. This same method is applicable to other classes of shock-resisting tools.

While studying the peculiar magnetic properties of various high-speed steels, as compared with other steels, the remarkable tenacity and elasticity of the test pieces at temperatures ranging from 300 to 1100 degrees F. was discovered. Further investigation proved that the samples could, without exception, be made very tough, without affecting their hardness to any marked degree, by heating them. Subsequent shock tests on alloy steel samples known to possess very little resistance to shock, showed plainly that these steels will stand a lot of pounding if sustained at artificial temperatures. Apparently the toughness of hardened steel increases with its temperature up to a certain point. It remains to be ascertained whether or not there is any distinct rule relating to toughness and temperature that would fit all kinds of steel, and it may be that eventually a formula will be found for determining the temperature at which one steel or another will give the best service.

An important fact also brought out by the pounding test is that fatigue, or crystallization, is effectively retarded, if not altogether prevented, by suitable artificial temperatures. Heat evidently gives a certain amount of molecular freedom which reduces the rigidity of the martensite. In this state of molecular freedom, the compressive strength of hardened tool steel grows to an extraordinary extent. We find that the crystals are kept in a state of elasticity by the steady flow of heat from a burner into a die-block, against the effects of the severe pounding of a drop-hammer, or the combination of shock and pressure in forging machines; in fact, increasing the temperature of the dies by artificial means seems to be the one effective remedy crystallization being prevented as borne out by actual shop experience.

Practical Application of the Method

Before the heating method was utilized by the Bard-Parker Co., much trouble was experienced with cold-forging dies. This company manufactures a surgical operating knife, the principal feature of which is a detachable blade, which may be replaced after use like the safety razor, thus obviating resharpening.

The dies are used for the handles of these knives. This scalpel handle (see Fig. 2) must be forged accurately, the end to which the blade fits having a tolerance of 0.001 inch. To obtain this accuracy, the handles are swaged cold in dies finished accurately and with a high polish. All name and trademark type is raised in thé die, thus avoiding machine sizing and stamping operations on the forgings and eliminating the possibility of inaccuracy. The handles are made of a non-ferrous nickel alloy, and require annealing between the successive rough- and finish-swaging operations under the drop-hammer, owing to the density of the material. With this cold drop-forging operation, success depends upon the dies, which soon fail to produce satisfactory work if used at ordinary temperatures. From the beginning, the heating method showed a great increase in the life of the dies.

The company referred to had tried every brand of die steel within reason, and every known method of routing and sinking the dies, both in hot and cold die-blocks. Nevertheless, production never exceeded a few hundred to a thousand forgings per die, so that the burden of die depreciation, coupled with the constantly increasing demand for the article, made it impractical to continue that method of production. Consequently, the Reinhardt heating method was put into operation. This method is covered by a U. S. letters patent, and is also protected in foreign countries.

Dies Used and Method of Heating to Prolong Life

The set of dies used for this forging operation was made up of a non-shrinkable semi-high-speed steel, containing about 2.5 per cent carbon, 14 per cent chromium, 1 per cent nickel, and 0.55 per cent manganese. The dies were hardened glass hard, and slightly drawn to relieve internal stresses. While in use under the drop-hammer, these dies are sustained at an artificial heat of 400 to 450 degrees F., by the use of gas burners. The first set of dies made and operated in this way produced eighteen thousand forgings, in comparison with a few hundred by the old method; the second pair of dies produced fourteen thousand forgings. The dies in both instances finally gave out by splitting in two, lengthwise of the impression. The fractures showed that the molecular structure of the steel had in no way been disturbed; there was no trace of crystallization, the fracture presenting a beautiful dense satin-like surface and being a good example of the forged grain of the die-block.

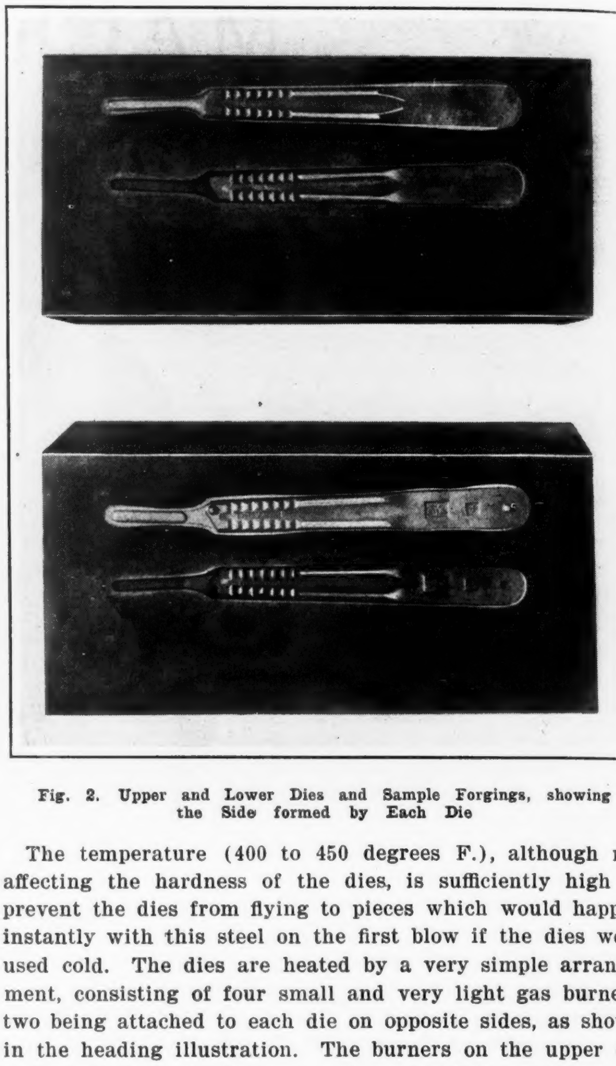


Fig. 2. Upper and Lower Dies and Sample Forgings, showing the Side formed by Each Die

The temperature (400 to 450 degrees F.), although not affecting the hardness of the dies, is sufficiently high to prevent the dies from flying to pieces which would happen instantly with this steel on the first blow if the dies were used cold. The dies are heated by a very simple arrangement, consisting of four small and very light gas burners, two being attached to each die on opposite sides, as shown in the heading illustration. The burners on the upper die were screwed to the hammer and connected by flexible tubes to the gas and air supply pipes.

The burner for the upper die is located at *A*, Fig. 1, and the burner for the lower die at *B*. Each burner is in the form of a perforated pipe, and the flame plays against one side of each die-block. Pilot lights have been installed to relight the burners at the top of the stroke, should they be extinguished by the jar of the blow. When the dies have been brought up to the required heat, which may be checked by bringing soldering wire into contact with them, the burners are turned down sufficiently to maintain the proper heat and offset the loss through radiation.

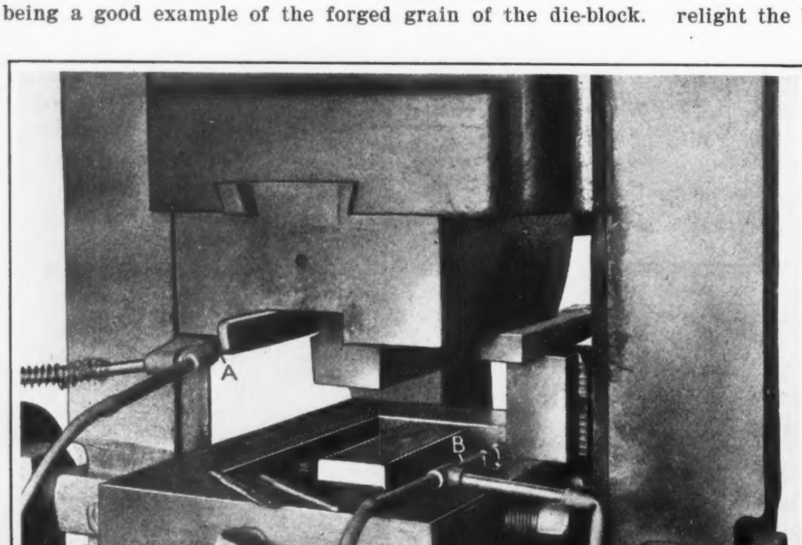


Fig. 1. Hammer equipped with Cold-forging Dies and Gas Burners for heating the Dies to a Temperature of 400 to 450 Degrees F. while in Use

Many other dies have been made since the first trial and used for protracted periods without showing any sign of crystallization, bearing out the previous experience concerning hardened dies that showed no sign of fatigue under heat operation. A set of old carbon steel dies previously used without artificial heating for this forging operation, is shown in Fig. 3. These dies produced 1100 forgings, but to obtain this number, it was necessary to use additional intermediate breaking-down and annealing operations. The upper die finally chipped out on the left-hand side, as the illustration shows, and there are small but objectionable imperfections on the lower die (not visible in the illustration).

Results of Additional Tests

Horizontal forging machines in which heading and gripper dies are used in manu-

facturing hot- and cold-forged bolts and rivets, afford an unusually good opportunity to show the benefits derived from the application of heat to the tools in operation, because practically unlimited quantities of bolts and rivets are made, and the tools are used until unfit for additional service. On small cold-forgings, figures have recently been obtained showing that heading dies of a high-carbon chromium steel, under a constant heat of about 400 degrees F., yield four to five times as many rivets as the average tool-steel dies used unheated. The tests have shown that these heading dies made of a very high-grade wear-resisting alloy steel, eventually require replacing on account of wear only, and do not show the defects (sponginess) typical of the unheated carbon tool-steel dies normally used, which make the latter unfit for further use.

This marked difference in the performance of the heated and unheated tools indicates that crystallization caused by fatigue is retarded in the heated dies to such an extent that the tools require replacement on account of wear long before they show any indication of crystallization. This makes it possible to use the tools again after they have been redressed, whereas tools that have been used without artificial heat have to be discarded on account of defects extending an inch or more down into the stock. Unfortunately, owing to the way these tools are confined, difficulties are experienced in applying the heat through Bunsen burners; and there is a lack of suitable electric heating devices having the necessary resistance to shock and vibration.

The numerous tests that have been carried out, or still await settlement, have brought good results. Perforated disks and knives for meat choppers are made by two concerns by the hundreds of thousands in steel dies containing 0.40 per cent carbon, 1.80 per cent tungsten, 1 per cent chromium, 0.85 per cent silicon, and 0.35 per cent manganese. These dies are maintained by gas torches at temperatures of about 400 degrees F. during operation. Production figures so far show an average of 15,000 disks per die, as against 3000 disks formerly obtained. The number of knives obtained per die has been increased six times.

Rail spikes, made in circular high-speed steel dies in a friction screw press, are produced at the rate of 30,000 spikes per die. Formerly these spikes were made in carbon steel dies having a total yield of 4000 to 5000. The carbon steel dies were kept cool by a stream of water, while now the high-speed steel dies are maintained at a temperature of 500 to 600 degrees F. when in use, the method having been reversed so far as temperature is concerned.

Another interesting example illustrating the possibilities of heated dies is found in the following record of performances for dies used for forging lock keys which are drop-forged while hot. These keys measure about 3 9/16 inches over-all, and 34,000 were forged in a single lower die artificially heated. After doing this work, the die was put away in excellent condition. This die is made of tungsten steel containing 12 per cent tungsten, 0.50 per cent carbon, and 3.50 per cent chromium.

To match this heated lower die, two unheated upper dies made of high-grade die steel were worn out while producing the 34,000 keys. The following is a record of their performance: Each of these dies first produced 5000 keys. It was then necessary to plane down both dies and re-engrave them. Die No. 1 then produced 3500 pieces after which re-engraving and re-hardening were necessary. Die No. 2 produced 4500 pieces, and then was planed down and re-engraved. Next in order, die No. 1 produced 4500 pieces, and then planing down and re-engraving became necessary. Die No. 2, after producing 5500 pieces, was scrapped. Finally, die No. 1, after producing 6000 pieces, was also scrapped.

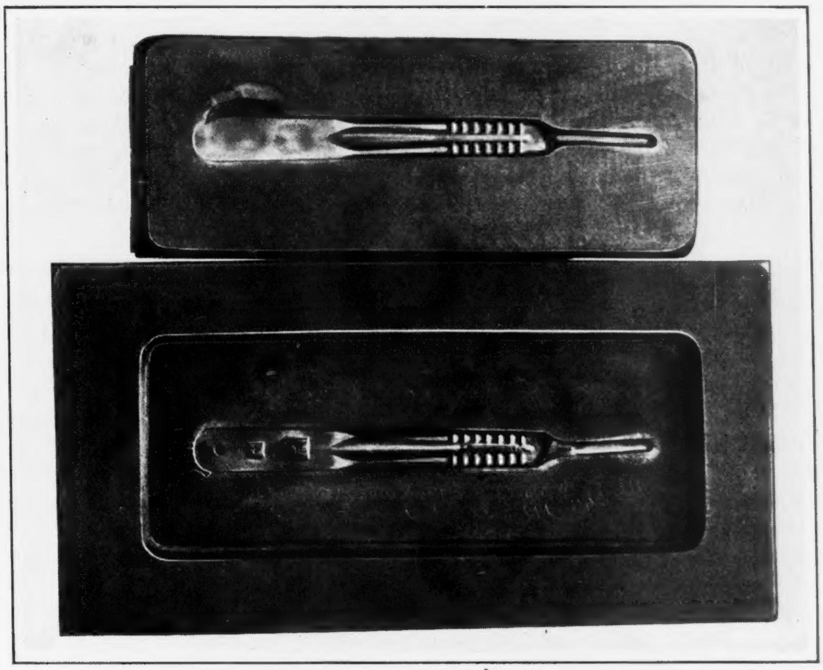


Fig. 3. Set of Carbon Steel Dies previously used without Artificial Heating—note Chipped out Spot at Left on Upper Die

Extent to which Process may be Applied

The field of application of this process is very large, and the heating method may be said to be of benefit wherever tools are used that have to stand wear and tear, and are subjected to shock, pressure, or vibration, still being expected to yield large production. Thus the method is of great interest to manufacturers of small drop-forgings used in large quantities, automobile, motorcycle and sewing machine parts, pliers, scissors, spoons and forks, hot- and cold-forged knife blades, parts of surgical and dental instruments, small forged and punched tools in general, hot- and cold-swaged parts and similar work.

Manufacturers of table ware have adopted the heating method for their dies without changing the brand of steel, simply with a view to reducing breakage and the risk of chipping. As one design of spoon is rarely required in large quantities, it is considered unnecessary to use a die of the expensive high-grade alloy steels. Dies of carbon steel are used and maintained at artificial heats of about 300 degrees F.

Perhaps the most interesting use of this method so far is in the drop-forging of high-speed side milling cutters. These forged cutters are practically ready for grinding and hardening after forging. The dies are made of tungsten steel containing 0.50 per cent carbon, 12 per cent tungsten, and 3 to 3.5 per cent chromium. Regular 18 per cent tungsten steel has also been used. Neither test has yet been brought to a conclusion, and since only one hundred and fifty 2½-inch and one hundred and sixty-nine 3-inch cutters have been made up to the time of this writing, the dies are still in perfect condition. Every one of the cutters came out perfect. The cost of producing these cutters was less than that of producing a similar number of machined cutters from solid bar stock, even including the cost of the dies for making the number of cutters mentioned.

From what has preceded, it is evident that heat means life to a shock-resisting tool, as it does to the human body. The vitality imparted by the proper degree of heat to the smallest crystal of a given body of hardened steel finds

expression in the almost incredible shock resistance of the combined mass of molecules that cannot be crushed. Thus the benefits of the new method may be likened to those of a steel, or alloy, that is yet to be discovered—one that combines hardness and toughness in the extreme.

Experiment with a Blanking Die

An interesting experiment was conducted to determine the effect of the artificial heating method as applied to a set of blanking dies used for cutting blanks from steel containing 1.28 per cent carbon and 2 per cent chromium. As these blanks are used for making the blades for Bard-Parker surgical knives, the edges of the blanks must be without burrs, and consequently maintaining sharp edges on the dies is of particular importance.

The production obtained ordinarily from a set of dies between grindings is about 35,000 blanks. When a set of dies was operated at a temperature of 350 degrees F., 65,000 blanks were cut and the dies were still sharp, but unfortunately it was necessary to discontinue the experiment at that point owing to a slight warping of the die-shoe. As the punch clearance is only 0.0005 inch, and as the pillars are provided with hardened and lapped close-fitting bushings, the result of this slight warping was to move the pillars out of alignment just enough to cause the bushings to bind to such an extent that there was danger of their "freezing." For this reason the test to determine the possible advantage of artificial heating in this case, could not be continued, and therefore, it is not regarded as conclusive, but has been referred to because it tends to support the theory that the artificial heating method is effective for blanking dies as well as for those used in connection with forging operations.

* * *

NEW PLAN FOR FINANCING INDUSTRIAL STANDARDIZATION

A new plan for financing the industrial standardization work of the United States, which provides for membership dues on the basis of one cent per each $1000 of the gross receipts of industrial corporations, has been approved by the executive committee of the American Engineering Standards Committee. Twenty of the most influential industrial executives of the country have accepted places on an advisory committee to cooperate with the ways and means committee in the financing of the Engineering Standards Committee.

The new class of members, whose dues will be apportioned in the manner mentioned, will be known as sustaining members, and a special service will be provided for them, including information bulletins on developments in standardization work in this country and in all other countries where industrial standardization is in progress. Heretofore the Engineering Standards Committee has been financed entirely by dues from the nine technical societies and seventeen national trade associations which, with seven departments of the federal government, constitute its present membership. Annual deficits were cleared by contributions from individual corporations. It is expected that the new plan of financing will provide an annual budget of $50,000 for the Standards Committee. The plan includes the appointment of an engineer-translator who will provide translations of standards developed in foreign countries for the information service to sustaining members.

* * *

The production of copper in 1922, according to the United States Geological Survey, as compiled from reports of the smelters covering the production for eleven months and the estimated production in December, was about 981,000,000 pounds, an increase of 475,000,000 pounds over 1921. Productive work was resumed at practically all the large mining companies by April, 1922, a year after the general shutdown of the copper mines.

STANDARDIZATION OF MACHINE PARTS

By RAYMOND B. TEMPLE
Designing Engineer, Blanchard Machine Co., Cambridge, Mass.

The difference between operating a plant at a profit and at a loss may depend on the attention given to seemingly unimportant details. This is especially true in times of business depression, when the plant may be forced to cut down its production to a small per cent of its normal capacity. Under such conditions, the problem of eliminating as far as possible the duplication of effort deserves special attention. In the engineering department of the Blanchard Machine Co. a system has been devised to cope with this particular problem, and the results obtained have shown the system to be of material assistance in cutting down production costs.

In designing a new machine, particular care is taken to utilize, as far as practicable, parts that have been designed for previously built machines. This procedure often saves considerable time that would otherwise be required for making new drawings. It also saves the expense and space necessary for carrying an increased variety of parts in stock. Before the new system was put into operation, it was necessary for the designer to spend a good deal of time looking over miscellaneous collections of drawings in order to determine if any previously made part could be adapted to the requirements of the new machine. More time was often spent in a fruitless search through old drawings than would be required to make a new drawing and have an entirely new part made.

System of Standardizing Parts

In order to remedy this condition, blueprints of each group of parts commonly used in all types of machines were made up and bound into book form for use in the drafting-room. The parts grouped together in these bound books included machine collets, special nuts, finished washers, pins, shoulder bolts, and similar parts. By reference to these readily accessible books, the designer could easily locate an old part that could be used without any changes, or perhaps a part would be found that could be used by modifying the design of the new machine slightly. If no part could be found that would suit the new requirements, the designer, with his knowledge of the similar parts already in use, could at least design the new piece as nearly as possible like those already made. This plan resulted in gradually building up a uniform line of parts.

In some instances, a systematic study of a particular group of parts shown in the bound blueprints enabled the designer to standardize the parts or make slight modifications in their design that would greatly reduce the total number of parts needed to meet all requirements. The system outlined can, of course, be extended to cover an unlimited variety of parts. It would eventually include such items as machine handles, name plates, and all kinds of special parts used in the company's products. The possibilities of cutting down production costs by this system of standardization have only begun to be realized in the plant referred to. However, there is ample evidence that the system is one that will increase profits if it is properly carried out.

* * *

PRODUCTION MEETING OF S. A. E.

The Society of Automotive Engineers will hold its annual production meeting this year at Cleveland, October 25 to 26, when papers on new processes, shop methods and production problems will be presented. The subjects dealt with at the production meetings cover all phases of factory economics, wage systems, planning, purchasing, and production methods. Last year the production meeting was held in Detroit. It is planned to change the place for the meeting from year to year, but always to hold it within the region where the major portion of the automobile industry is located.

Types of Polishing Machines

By BRADFORD H. DIVINE, President Divine Bros. Co., Utica, N. Y., and President of the Metal Finishers' Equipment Association

THERE are many different types of polishing machines in use adapted to a great variety of work, ranging all the way from a simple cheap cast-iron bench lathe up to the elaborate automatic machine. Bearings of all kinds are used—cast iron, babbitt, and bronze bearings, plain, roller, and ball bearings. Machines are available in types and styles to meet the requirements of any purchaser. The designs incorporate single-end and double-end types, floor lathes with straight columns, flaring columns, etc., in a very large assortment.

In the early days of polishing when the wheels were made in the factories using them, very little attention was paid to the design of polishing lathes. This was due to the fact that the polishing wheels were generally of small diameter, made out of wooden blocks and faced with leather straps, or out of disks of sail cloth glued together, or of similar types, and the strains set up while operating were small. A wheel larger than 12 inches in diameter was rare, the common sizes being 8 and 10 inches.

Fig. 1. Cupola Jack Polishing Machine

The ordinary type of polishing lathe consisted simply of a cast-iron column with a base for support, placed either on a bench or on the floor, with the upper part of the column spreading out into a pair of V- or U-shaped arms fitted with cast-iron or babbitt bearings. The bearing boxes were usually very short, and the spindles long in proportion, so that the wheel was carried at some distance from the frame of the lathe, to provide sufficient clearance for turning the work around the polishing wheel. Even with wheels of light weight, the pressure applied by the polisher on the wheel produced a strain that made the bearings very short-lived. The cost of the repairs was a relatively modest item, but the loose vibrating shaft or wheel prevented the operator from producing a well polished surface, or from doing his work cheaply or rapidly. Often the simplest and cheapest forms of floor and bench grinding lathes were used for polishing, but such lathes were not built to stand the higher polishing speeds, and caused trouble.

The Cupola Jack Polishing Machine

Another type of polishing machine is the so-called "cupola jack," shown in Fig. 1, which is still extensively used, especially in the cutlery industry. This machine is quite different in design from the column type with the double-end shaft just described. The cupola jack frame consists of a cast-iron base with two cast-iron upright columns, connected by a brace at the middle. The upper end of each column is arranged to hold a removable hard-wood block in a horizontal position, with the end of the grain against the end of the shaft, and fastened in place by a set-screw. The spindle and arbor hole of the wheel are both tapered, and the polishing wheel is driven on the spindle with a tight fit. The ends of the spindle are tapered down to points, and fitted into countersunk depressions cut into the ends of the hard-wood blocks which constitute the bearings.

The driving pulley is permanently fixed to the tapered shaft. The spindle is removed when a wheel is to be replaced by throwing the belt off the pulley and releasing the set-screw clamp on one of the wooden block bearings, which is moved out sufficiently to enable the spindle to be removed. The blocks are usually of rock maple, and originally were lubricated by simply applying tallow to the countersunk bearings. An improvement upon this was made when the blocks were saturated or boiled in oil.

One of the disadvantages of this type of bearing was that the blocks used to split and tear out, especially when work was caught in the wheel, and many serious accidents happened from this cause. This was eliminated by driving a well seasoned piece of maple into a pipe and then boiling it in oil, so that the swelling of the wood held the block firmly in the pipe, and the set-screws for holding the bearing in place were applied to the pipe instead of to the wood. Reinforced in this way, the wood bearing had less chance of splitting, and as a consequence, accidents were practically eliminated.

Advantages of Large Polishing Wheels

As time went on, the advantages of larger and heavier wheels with higher speeds, and the demand for the increased production possible with such wheels and speeds brought into use more wheels of from 12 to 24 inches in diameter than those of the smaller sizes. This necessitated polishing lathes of heavier and stronger construction, and bearings of a better type. The larger polishing wheel gives smoother action and better contact, and makes possible lower rotative speeds for the same peripheral speeds, thereby causing less wear and insuring longer life of the polishing machine. Furthermore, the number of wheels required is less, and large wheels are no more expensive in upkeep than smaller ones.

The unit cost for removing, cleaning, reheading and replacing wheels is practically the same for wheels of various diameters. The time required for making the wheel change is the same per unit, regardless of the size of the wheel; but the advantage gained by using a larger wheel will be appreciated when it is realized that a 16-inch wheel running at 1800 revolutions per minute has a peripheral speed of 7538 feet per minute, whereas the corresponding peripheral speed for a 10-inch wheel is only 4712 feet per minute. In other words, a 10-inch wheel, to give the surface speed of a 16-inch wheel running at 1800 revolutions per minute, would

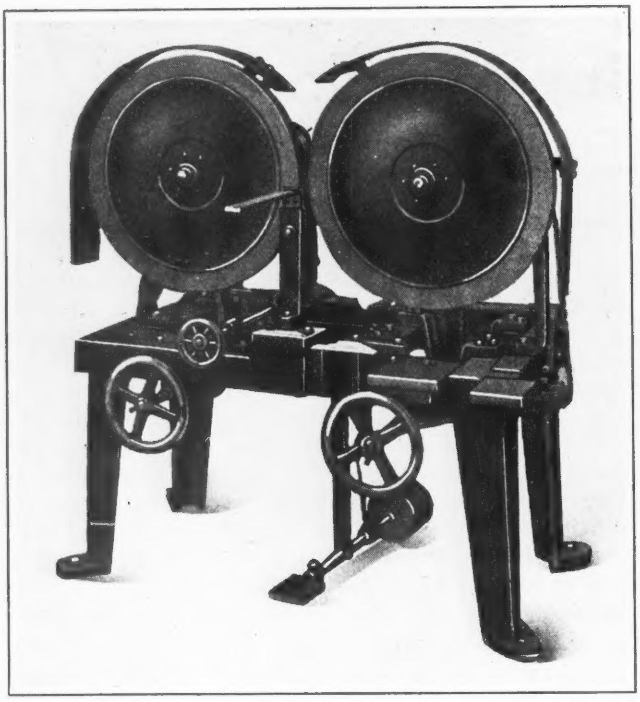


Fig. 2. Semi-automatic Double-head Polishing Machine for Knife Blades

require a speed of 2900 revolutions per minute. Briefly, a larger polishing wheel is more efficient than a smaller one, but this does not mean that small wheels should not sometimes be used; they are, of course, the only means by which surfaces having small radii can be reached.

Drives for Polishing Machines

Before the introduction of the direct-connected electric motor-driven machines, polishing lathes were generally belt-driven either from an overhead lineshaft or from a lineshaft placed against the wall of the room and using horizontal belts. The horizontal belt gave the operator more clearance for his work, while in some cases the vertical belt could not be used at all, because of danger to the operator through interference of the work with the belt. This dangerous condition existed before the present belt-guarding systems were introduced.

Another development was the drop-head type of machine in which the spindle was operated by an under-driven belt connected to a lineshaft usually placed in a pit directly under the line of polishing machines when they were on the ground floor, or from a lineshaft attached to the ceiling below when the machines were on upper floors. In such machines, descriptions of which have formerly appeared in the technical press, the head carrying the boxes and shaft was placed on a hinge, and was raised or lowered by means of a lever. In one position of the lever, the shaft and pulley were brought up against the belt, tightening it; in the other position, this was reversed, the shaft dropping and the pulley making contact with a brake which almost instantly stopped the machine.

Another form of this lever-controlled machine is found in the brake and idler type, in which the movement of the lever to stop the machine releases the idler, which, during the operation of the machine, keeps the belt between the driving and driven pulleys tight. The same motion of the lever applies a brake and stops the machine, and the reverse of these operations starts it. Such machines as these were time-savers, as well as accident preventers, and while more expensive than the simple open-belt type, were much more economical and easier to handle.

Many attempts have been made to design a satisfactory double-end lathe with two independent shafts driven by a single belt and clutches, but few such machines have been successful in everyday use. The advantage obtained with such machines is the ability of each operator to start and stop independently of his mate at the other end of the machine, at a great saving in time and a considerable increase in production. The great disadvantage of a double-end solid-spindle lathe is the stopping of production by both operators when either one must stop to change wheels or shut down for any reason.

The nearest approach to the single-column two-spindle lathe which has been brought out successfully is a single-column lathe with two independent spindles driven by two belts, eliminating the clutches. This machine has recently been described in the technical press. There may be a disadvantage in the two belts, but the advantage in the saving of time of each operator and the conservation of floor space in this type of machine is evident.

Motor-driven Polishing Machines

The development of the direct-connected motor-driven polishing lathe was a real step in advance. In this type of machine, of which several types have been illustrated and described in the technical press from time to time, all belts are done away with, making a self-contained unit, without projections to interfere with the handling of the work. The machine can be set in position without regard to the location of pulleys or lineshaft. It can be placed at any angle, so as to obtain the best light in the room, and has many other advantages. The only disadvantage is found when an alternating-current motor is used, because it runs at one set speed only, determined by the type of the motor; and since polishing wheels under certain conditions have to be of different diameters, it is not always possible, where the work determines the diameter of the polishing wheel, to employ peripheral speeds best adapted to rapid or proper production. When direct-current machines are used, the speed can easily be adjusted to give the proper cutting or peripheral speed for the work.

Motors with open frames are not suitable for polishing machines, because abrasive grains from the polishing wheels will get into the bearings and destroy them. However, in an electrically driven lathe with the motor case tight enough to be dustproof, the possibility of the motor overheating must be reckoned with. This can be guarded against by ventilating the motor case with intake and exhaust tubes connected to the case. The intake, of course, must have its openings outside of the polishing room. The exhaust is commonly connected with the exhaust system of the polishing room. This condition is taken account of in the manufacture of some electrically driven lathes in which openings are left for pipe connections in the castings of the frame.

Solid Floors Required for Polishing Machines

With the high speeds used in modern polishing lathes, proper foundations are imperative. While much has been done by some manufacturers in designing the shapes and weights of the columns of machines to absorb vibration, still, any high speed machine, when placed on an ordinary wooden floor, will produce vibrations that will seriously fatigue the polisher and also influence the quality of the work. Fatigue of the operator is one of the most important elements in the cost of polishing; consequently everything should be done to eliminate this condition as far as possible.

The proper setting of any type of polishing lathe to insure solidity and prevent vibration is extremely important, especially for delicate polishing processes and precision work, or where the character of the polished surface will be affected by a vibrating wheel. In many plants the floors are none too heavy. Where the buildings are put up with the usual 8- by 10-inch or 2- by 10- or 12-inch stringers and joists, and the floors are not thick enough to take the hold-down set-screws of the polishing lathe, the vibration often loosens the nails in the floor and tends to tear it up in places. A remedy that has been adopted in a number of cases, when nothing interferes below the floors, to run a heavy timber,

6- by 8-inch or 8- by 10-inch, lengthwise under the joists and under the row of polishing machines, and bolt right down through it so that any movement of one particular machine will be communicated through a wide area of flooring.

Even in modern factory buildings, with steel girders and wooden floors, where the ends of the flooring are supported on a comparatively small wooden rib or filling on the girder, a vibrating polishing lathe will have a tendency to lift the whole wooden mass, even with the usual 3- to 5-inch thickness of floor. A remedy in such a case is to put a heavy timber or girder underneath the supporting steel girders that carry the floor. With this extra member lengthwise, a row of polishing machines bolted down through the whole mass ties the polishing machines to the frame of the building itself and reduces vibration to a minimum.

Automatic and Semi-automatic Machines and Attachments

Fatigue of the operator, labor troubles, the general character of polishing work, the difficulty of obtaining intelligent operators, and strenuous business competition has brought about the demand for automatic or semi-automatic machines and attachments wherever work is done on a production basis, and where accuracy of finish and other requirements cannot be met by the old-fashioned hand process. Automatic and semi-automatic polishing and buffing machines find general application where large quantities of work are regularly performed. This includes all classes of work from the polishing of small articles such as alarm clock bells and electric light sockets to hot air furnace registers, 4 feet square. The forms of these machines are many: Some handle just flat work with large areas; some handle circular or cylindrical work at any angle; and some handle composite contours and surfaces of any kind, such as tea kettles and hollow-ware bodies.

Automatic machines are so arranged, especially for buffing, that the head of the machine carrying the work can be set in any desired position in relation to the buffing wheels. The movement of the wheel-head is always under the direct control of the operator. Machines of this kind revolve the work either with or against the rotation of the wheel, as desired. The rotation of the work can be stopped by a foot-treadle, which applies the brake and releases the chuck. Such machines are designed to carry roughing and finishing wheels at the same time. The use of automatic and semi-automatic flexible grinding and polishing machines has probably reached greater application in the cutlery and stove trade than in any other one line of polishing work.

For the surface operations of glazing, fining, and finishing on kitchen knives, carving knives, butcher knives, and all steel blades of approximately flat contour that are not to be plated, a double-head machine, such as shown in Fig. 2, is used. This machine has two polishing wheels revolving in opposite directions. One wheel-arbor is fixed and stationary, while the other is movable and provided with a spring tension to regulate the pressure of the wheels against the knife. When the knife is put in place, the space between the wheels is widened. The two wheels are then allowed to come together, both pressing against the knife blade. The knife blade is supported on a steel rest and when the wheels have closed on it the operator draws it forward from between the wheels. The important point in this operation is for the wheels to have the proper amount of cushion or softness to flatten and cover the entire width of the blade at each stroke. Different widths of knife blades require wheels of different densities and covering capacities. Wide-blade knives, such as butcher and carving knives, require larger wheels, with an approximately flatter contour, than blades of pocket knives, for which much smaller wheels are used.

Another form of automatic machine in use for table cutlery and to some extent for other work of the same general shape and size is shown in Fig. 3. This machine produces an effect on the metal similar to damaskeening. This is done by applying the strokes of the polishing operation in such a manner that there is no distinct straight stroke or scratch, as would be the case with a double-head machine or with any other process of applying the work to the wheel. The type of wheel used is one with a cushion which can be made of any required density.

The knife is placed in a holder, which grasps the handle, as shown in Fig. 4, and the blade is reinforced by a back piece. The knife lies in a position parallel to the axis of the polishing wheel, and the motion of the machine brings the blade down along the face of the wheel, at the same time moving the knife back and forth from end to end across the face, so that the wheel travels the complete length of the blade a number of times while the latter is passing along the face of the wheel. In other words, two motions take place at the same time. A blending of the polishing marks results from these motions, and the effect is comparable to the process of damaskeening. The knife blade, when finished ready for plating, presents a dull matter surface with no straight polishing scratches visible.

Machines of this type have become standardized throughout the entire cutlery trade in America and England. Fig. 4 shows the end of a machine of this type with the knife in position at *A*. Both this machine and the double-head machine in Fig. 2 require polishing wheels of a special type made with great accuracy and care as to uniformity of density, flexibility of face, perfection in balance and true-running qualities.

Another form of automatic machine in common use is a surface grinding and polishing machine for flat surfaces, as for example, such work as the tops of stoves, registers for furnaces and any class of work that is approximately flat and of large area. This machine embodies a travel board and conveyor to which the work is attached. Various polishing wheels for the different operations are automatically passed over the entire surface of the work as it progresses, covering all operations from coarse grinding to the final finish. The value of such a machine is shown by the fact that in one particular installation a register, 40 inches square, is ground, polished, and finished every five minutes. The processes involved are solid grinding, flexible grinding, and polishing. The finish required is a perfectly smooth surface to receive enamel or to be plated.

Another form of machine is one often called "homemade," in which a device is arranged on the head of a metal planer to carry three or four polishing wheels, the positions of the wheels corresponding to the spokes of a wheel. Magnetic

Fig. 3. Automatic Glazing Machine for Table Cutlery

chucks are often used on such machines, especially for thin work that is difficult to hold in position on the bed with clamps, and especially where it is necessary that no devices interfere with the free passage of the polishing wheels over the surface of the work.

Machines of this type are used on skate blades, which, when nested together, will permit about 100 blades to be operated on at one time. This form of machine is also particularly adaptable to long steel shapes, such as parts of textile machinery. The wheels are so arranged that when the work starts, one wheel is brought down on the work through the proper pressure device, and that wheel continues in action as long as the abrasive surface is in good condition, but as soon as it becomes dull, it is relieved and another wheel brought into play in turret fashion, and the operation continues without interruption. On work of this kind, where the pieces are long and the application of the polishing wheel must be continuous, the effect of heat must be guarded against, as it softens the head of glue and emery. The nest of wheels described overcomes this difficulty.

The machines described in the foregoing are those that might be called the standard styles and that are in common use. In addition to these, a great many special machines have been built, usually for the use of the concerns making them, and it is not often that such machines are offered for sale.

A concern fitting up a new plant is often at a double disadvantage when it comes to the installation of polishing machines. First, it seldom consults competent engineers with sufficiently broad experience in advising and recommending the proper type of machine for the intended work; second, many of the most advantageous types of machines are made as a side line by concerns whose regular business is the manufacture of lines of machines or tools that are foreign to polishing, and the purchaser does not know where to locate the makers and cannot get a good survey of the complete line of machines on the market. In addition to this, unfortunately, such machines often are found only in one size, and the choice is therefore limited.

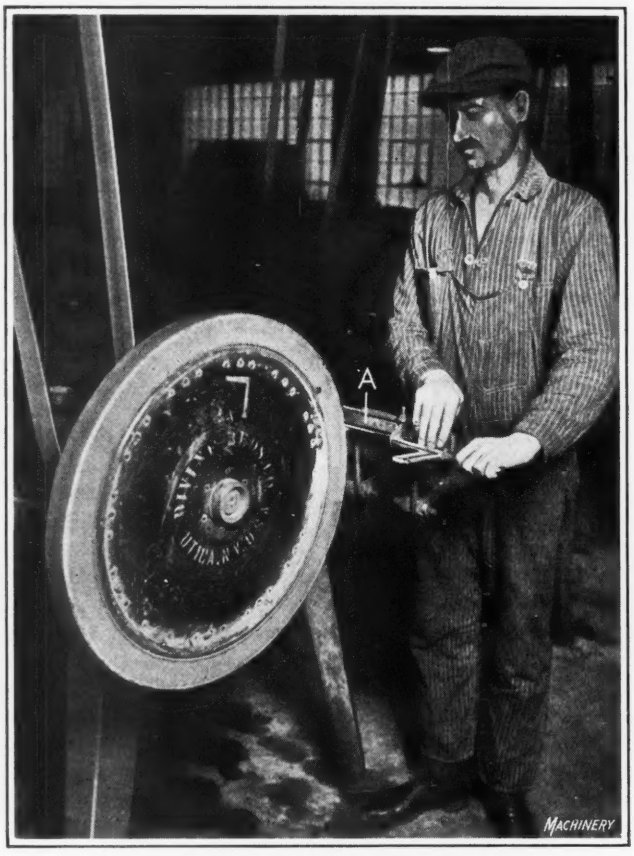


Fig. 4. Automatic Table Knife Glazing Machine, showing Method of holding the Knives

Illustrative of the limited knowledge that even the best machine designers show at times of conditions attending the use of polishing lathes, is a case of a concern, very well known in its own particular field, that produced a line of polishing machines. This concern called one type a buffing machine and another type a polishing machine. The buffing machine was equipped with ball bearings, and the polishing machine with ring-oiling bearings. The company said that it could not use ball bearings in a polishing machine because *in grinding* it had found that ball bearings would not stand the strain. It was apparent that this concern had little or no knowledge of the fact that polishing practice in regard to machine design varies greatly from grinding practice.

The design and construction of automatic machines was retarded considerably for a similar reason. The designer of the machine usually figured that the wheel could work constantly without interruption, like a grinding wheel, but failed to recognize the fact that continued application of a polishing wheel to metal would cause the glue that holds the abrasive on the wheel to soften, and the abrasive would be stripped from the wheel in a few minutes' use. In other words, no provision was made for the cooling of the wheels, and many an automatic machine correct in other respects failed when put into use for this reason. It is evident that the design and construction of polishing and buffing lathes must be founded on experience taken from within this department of the mechanical arts, and must not be predicated on grinding practice.

* * *

SELLING A PATENT BY MAIL

The first principle of successful selling by mail is a thorough knowledge of the product on the part of the sales correspondent. Therefore, the inventor, or somebody who is equally well informed about the features of the invention, is the best person to set forth the advantages of a new patented device. The Business Consultation Bureau of the La Salle Extension University points out four specific details that should be clearly covered in a letter or statement intending to interest others in the commercial exploitation of a patent.

1. The advantages of the new device over other well-known devices that may already be on the market for the same or similar purposes.
2. The cost of its production, based, if possible, upon personal experience or upon quotations supplied by manufacturers for its production in whatever quantities would be likely to be required.
3. An outline of the market to be supplied, determined in accordance with the nature of the invention.
4. The selling price that may be expected, and the profits that would be necessary in order to interest the manufacturer, wholesaler, and retailer.

After the advantages of the invention have been recorded in this way, the next step is to prepare a list of manufacturers or men interested in the industry to which the invention is applicable, and to send them a letter containing the specific points mentioned—briefly but comprehensively covering each phase of the subject.

* * *

The total tonnage of ships launched in 1922 in all the countries of the world, was 2,467,000, as compared with an average of 2,740,000 tons annually during the five years preceding the world war. The average during the five years 1917 to 1921 was 5,150,000 tons. Of the tonnage launched in 1922, Great Britain was responsible for 40 per cent, Germany coming next in order with about 23 per cent, and France with about 8 per cent. Ocean-going shipping only being considered, Holland, Italy, the United States, and Japan follow in the order mentioned.

Work-holding Surfaces of Machine Tools

Table Design for Different Types of Machines—Second of Three Articles

By FRED HORNER

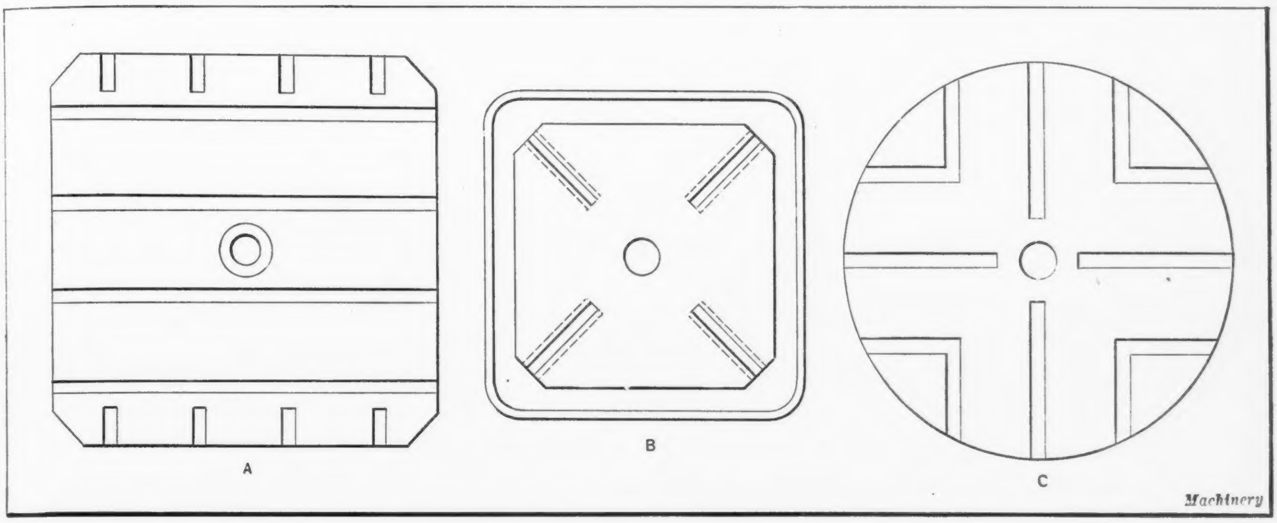


Fig. 8. Various Methods of arranging Slots in Square and Round Tables of Slotters and Drilling Machines

THE first installment of this article, published in April MACHINERY, described certain factors affecting the design of machine tables or work-holding surfaces, and described different designs to meet various conditions. Increase of holding area by the use of supplementary supports, the influence of thrust on table design, plain work-holding surfaces, securing bolts to surfaces by tapped holes, the use of through holes and slots, and arrangement of T-slots were dealt with in the April installment. The present article will treat of the arrangement of slots in square and circular tables, and the influence of drainage on T-slot arrangement.

Arrangement of T-slots in Square and Circular Tables

A long narrow table, such as found on rail-planers, is convenient for placing bolts and using as much of the width as possible for the work, if short side slots are added, as illustrated at *C*, Fig. 5 (See April installment). This practice is also common on large rotary tables for slotters, as shown at *A*, Fig. 8, and for the bases of heavy radial drilling machines. Some varied examples of T-slot arrangements for square and circular tables are shown at *B*, Fig. 8, for a drilling machine, and at *C*, Fig. 8, and *A* and *B*, Fig. 9, for slotters. It will be noted that in each of the slotter tables more than two slots run parallel, with a consequent advantage for many kinds of clamping and for adjustment of angle-plates and other fixtures that require bolting with pairs of bolts in a foot.

As in lathe faceplates, certain tables, notably those for circular milling operations and boring mills, have all the slots placed radially and in sets of three, four, or six of equal lengths, with intermediate slots of other lengths. This arrangement covers, in an effective way, the whole area that can possibly be devoted to slots. The principal departure from the radial arrangement is made when dogs or jaws are to be employed on the table, and then there are two alternatives. One is to cut enlarged grooves, distinct from the T-slots, to accommodate the slides of the jaws, as shown at *A*, Fig. 12. In the other method, the jaws are raised and clamped with duplex parallel slots, as illustrated at *B*. The remainder of the slots for bolts either run radially or are grouped in sets parallel to the jaw slots. Large boring-mill tables may also have duplex jaw slots in combination with a large number of bolting

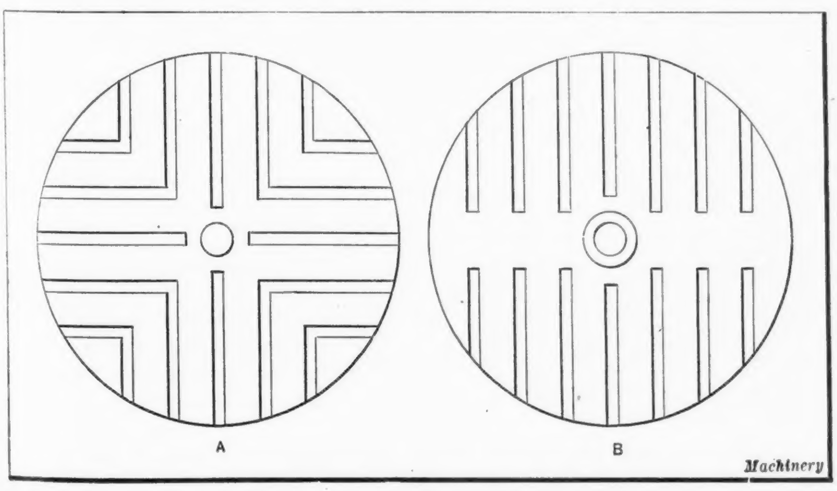


Fig. 9. Slot Lay-out of Two Round Slotter Tables

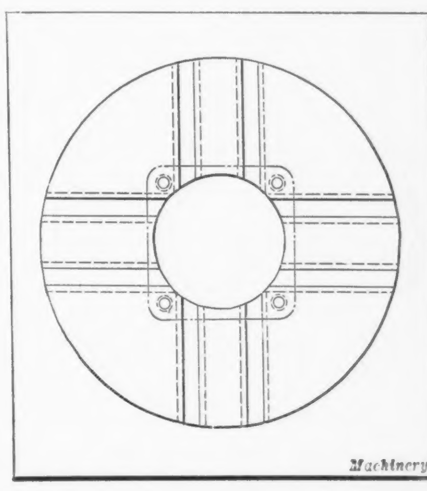


Fig. 10. Gear Hobber Table

slots, which are interspaced and furnished with end pockets, as shown in Fig. 13. The table illustrated is 20 feet in diameter and is cast in halves.

The combination of a central arbor with a support for the work affects the design of T-slots: sometimes the slots are utilized to hold a central bracket, or holes for cap-screws may be tapped into the table to fasten the bracket, and the slots reserved for the holding-down bolts. The latter is the case in the gear-hobber table shown in Fig. 10, where the square bracket shown in dot-and-dash outline, carries the arbor, while the slots are used for the rim blockings and any clamping or driving bolts that may be needed for the work.

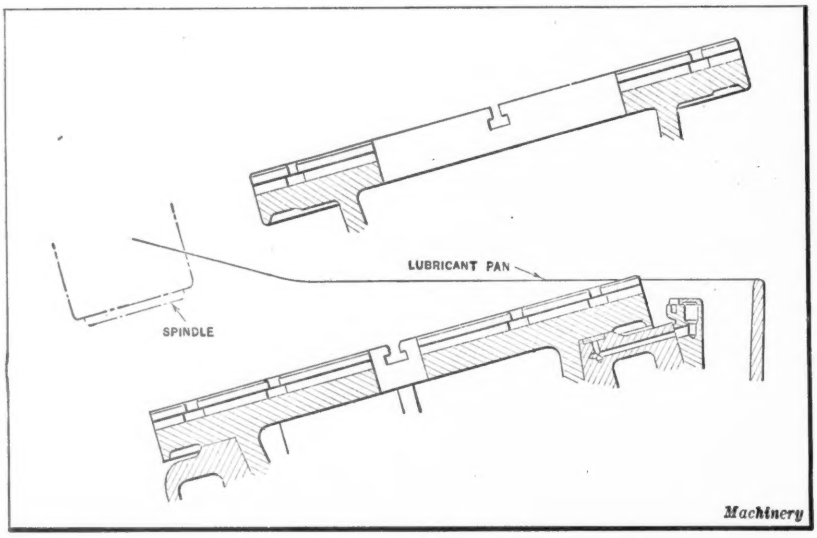


Fig. 11. Two Types of Table supplied on a Milling Machine of the Tilted Rotary Type

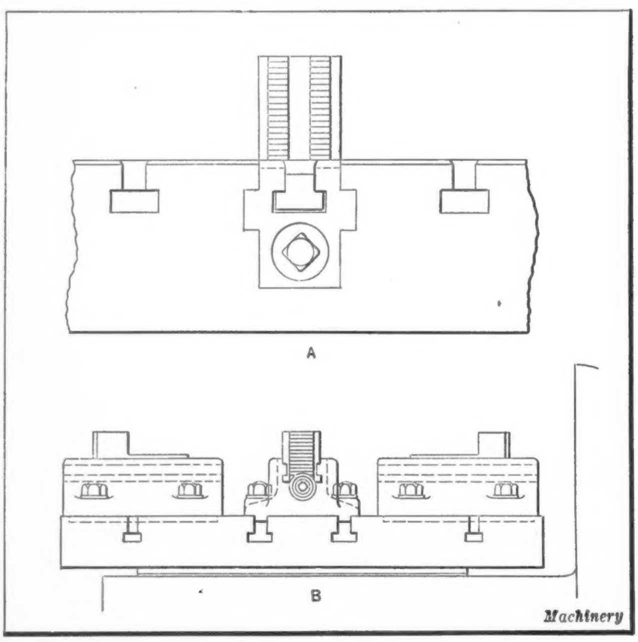


Fig. 12. Two Methods of mounting Radial Sliding Jaws on a Table

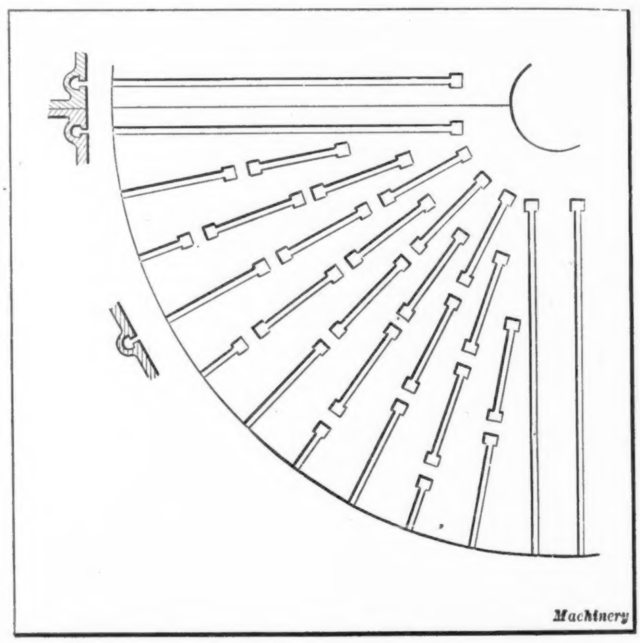


Fig. 13. Boring Mill Table with Jaw Slots and Additional Short Slots

Complete circular slots are usually not of any particular advantage for ordinary clamping purposes, a collection of straight ones being generally more handy. On rotary milling tables, however, they may be an increased convenience when either station or continuous milling is performed, because the work, or the fixtures holding it, may be slid around the table into the required positions, the bolts sliding in the circular slots without hindrance. This special lay-out does not preclude the addition of several radial slots.

A rotary milling machine of the tilted type has a table of the form shown in Fig. 11; the upper view shows a table provided with a large central hole, and the lower, one of ordinary design. Four radial slots are furnished on each table, in addition to one circular slot on the large-hole type, and two on the small-hole type. The reason for inclining the table to an angle of 15 degrees is to enable a large volume of lubricant to be pumped on without splashing, and to be drained readily, so that the chips will be carried off immediately from the table and fixtures.

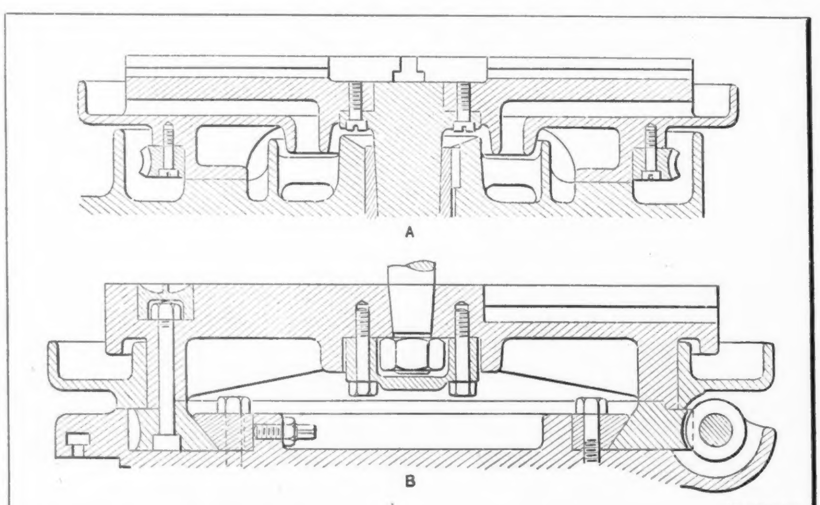


Fig. 14. (A) Circular Table with Integral Coolant Draining Rim; (B) Design in which the Drainage Rim is Separate from the Table

The system of drainage from a circular table may comprise the principle of a fixed catching rim or one cast integral with the table. The second method does not furnish a convenient escape for the coolant, unless there are capacious relief passages leading down into a circular trough having outlets as shown at *A*, Fig. 14. The fixed rim system is less

complicated, as the drainage may take place at any suitable point. The rotary table illustrated at *B* moves within the rim and has a turned down lip to drop the coolant well into the rim.

The idea represented at *A* is of value for reciprocating tables, if the quantity of coolant is large, and a considerable amount of dust accumulates on the table, as in grinding machines. For example, the table of a certain type of deep face grinding machine is cast hollow, as illustrated at *A*, Fig. 15, the water falling on the end trays and running through the passages and off the table by way of the side opening, as indicated by the arrow. Draining from the table surface is taken care of by long flaps (not illustrated) below the left-hand side, while on the right-hand side there is a groove. A groove at the bottom of each T-slot is another device for rapidly draining coolant from the table, provided the chips are of such a nature that they wash out freely. The section of a slot so formed resembles that shown at *B*.

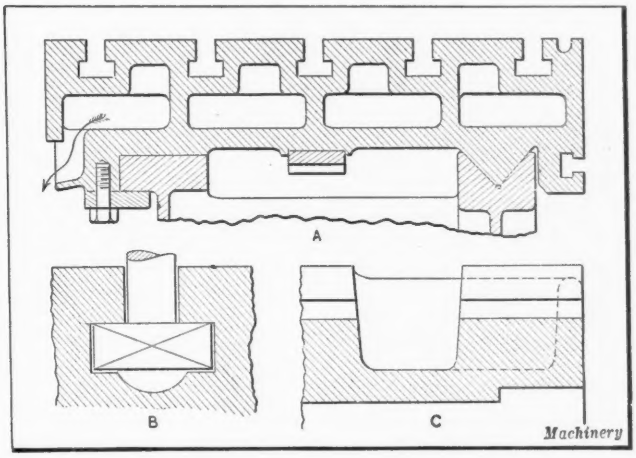


Fig. 15. (A) Table cast Hollow to facilitate Drainage of Coolant; (B) T-slot grooved at Bottom; (C) Proportions of Coolant Pocket for Uncovered Slots

One of the most troublesome tables to deal with is that of a milling machine when a great quantity of coolant is passed over the work and the chips are fine. The problem is how to take care of all the coolant without delay of operation due to the troughs and outlet pipes becoming choked. The first essential is large capacity for escape of the coolant, and an efficient straining apparatus that will operate without frequent cleaning.

On small tables using comparatively small quantities of coolant, the provision of draining grooves along the top, leading into end pockets supplied with a wire over which the liquid flows, and out by way of a cock, will suffice. Such a design is shown at *A*, Fig. 16. A can is hung under the cock, or a rubber connection may be made down to a receptacle.

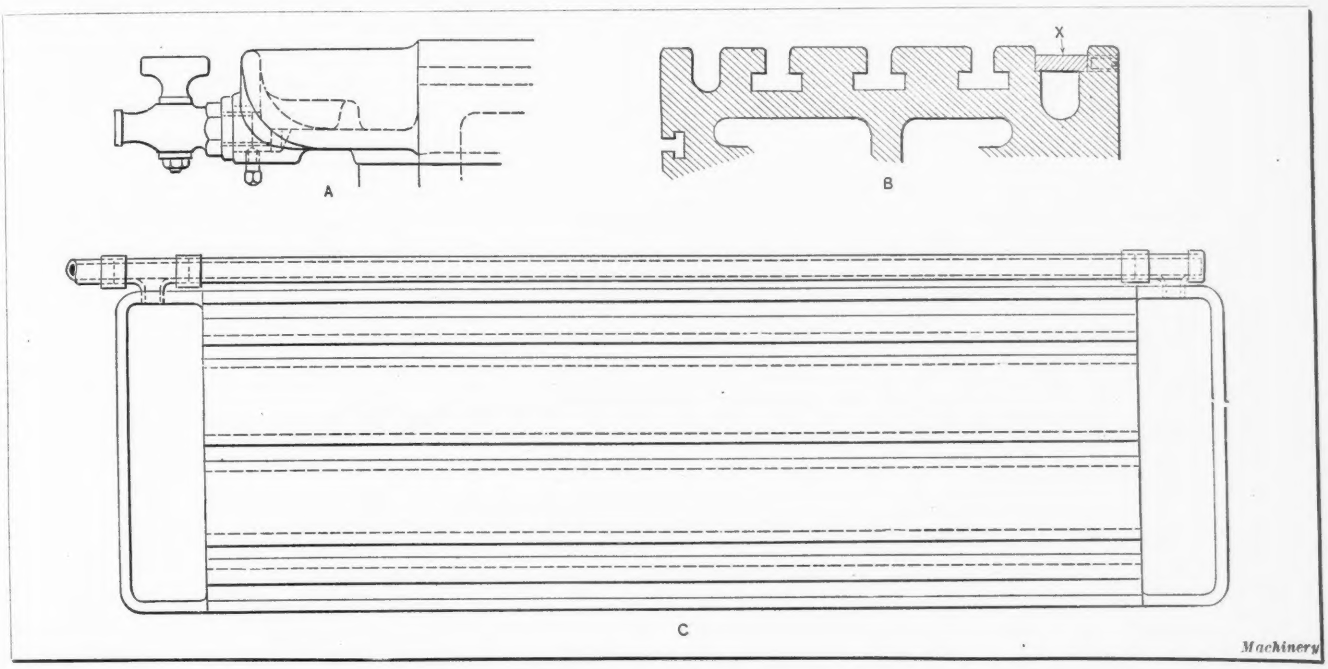


Fig. 16. Various Methods of providing for the Drainage of Coolant from Tables

Iron piping joined up to each pocket, as shown at *C*, supplies an alternative of greater drainage capacity, which gives no trouble, provided the outlet mouths are properly covered with strainers. A half-round groove milled close to each side prevents overflow of coolant from the table.

Instead of employing an outside pipe to connect the two pockets, the junction may be effected within the table itself by a method that saves time as regards cleaning. Thus, at *B* in Fig. 16, a steel strip *X* is locked over a groove by means of set-screws to form a passage that can be readily cleaned out. The continuation of the T-slots into the end rims of the table at *C*, as mentioned in the first installment, would increase the effective area of the working surface, and permit bolts to

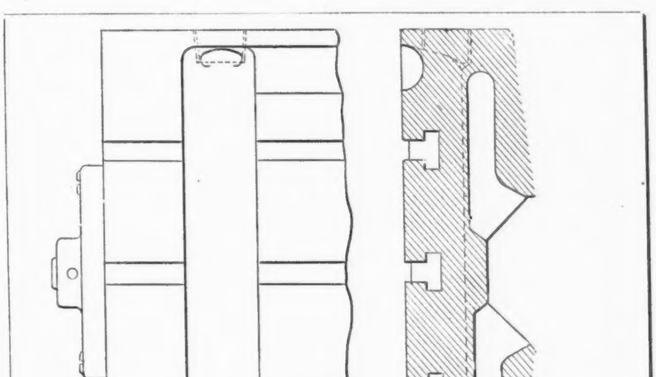


Fig. 17. Table with Grooves in Extreme Left-hand End to receive Tongues of Attachments, and Short T-slots cut in Right-hand End

be used right out to the ends as stops and for clamping purposes. In that case, the end rims, of course, would need to be thickened.

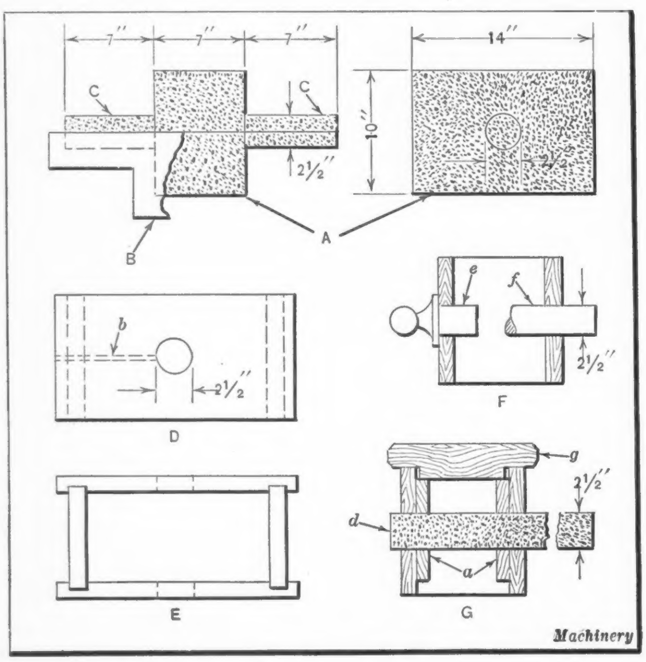
Deepened pockets are essential if the T-slots are not covered up by end plates or castings. At *C*, Fig. 15, are shown the proper proportions of a pocket and slot for uncovered slots. A table is illustrated in Fig. 17, in which grooves are milled at the left end to receive the tongues of attachments, while at the right end short T-slots are cut. A thin wall of metal is left between the slots and the coolant pocket to prevent the escape of coolant. Sieves or strainers laid in the pockets will prevent them from becoming choked up. These should be covered with solid plates when cast iron is being machined.

* * *

EASILY CONSTRUCTED CORE-BOX

By M. E. DUGGAN

During a recent visit to a foundry, the writer's attention was directed to a large pattern that was being molded. Three cores of the general shape shown at *A* in the illustration were required for the mold. The cores were of different



Quickly Constructed Core-box used for Three Sizes of Cores

sizes, and three half core-boxes were used in their production, the full core being made up by pasting two of the half cores together. A broken section of one of the core-boxes is shown at *B*. This method of making cores is considered good practice, and would probably be used in nine out of ten cases. However, there is no standard to be followed in making patterns or in molding, and for this reason the writer makes it a practice, when in the foundry, to study the construction of patterns and core-boxes sent there by various customers. The apprentice at the patternmaking trade who will do this will learn much about patternmaking practice that could not be learned in one shop.

The core-box referred to brought to the writer's mind a similar job which was observed in another foundry. In the latter case, three cores were used in making the mold. The dimensions of the largest of the three cores are shown in the two views of core *A*. In the center of the main body of this core were two branch cores *C*.

A casting, the molding of which called for the use of one core of the dimensions shown at *A*, another core slightly smaller, and a third core smaller than either of the other two, was required to fill a rush order. On looking for the patterns in the pattern loft, it was found that the three core-boxes were missing. The time required to make core-boxes like the original ones would delay the production of the casting from twenty-four to forty-eight hours. So a short-cut method, as described in the following, was employed. While this method is rather unusual, it is practical and can be applied to various molding jobs.

A side view of the core-box used in producing the three sizes of cores is shown at *D*, and a bottom view at *E*. The method used to adapt the large size core-box to the production of the smaller sized cores is illustrated at *G*. The box, when used for the smaller cores, was provided with filler pieces *a*, located within the large box, as shown. Small blocks of wood were placed under the bottom edges of the filler pieces to keep the latter in the correct position. The box was adapted for holding the intermediate sized core by cutting strips of wood to the required thickness and placing them on top of the filler pieces.

The two sides that form the large box and the two filler pieces *a* were stacked one on top of the other in their correct relationship, and then nailed together temporarily. The circular opening for the central hole was next laid out and scribed. The hole was then cut out to the scribed lines with a band saw, the saw being fed in to the scribed lines from one end of the box, as indicated by the dotted lines *b*, in the view at *D*. The sides and ends of the box made to form the largest core were then assembled and securely fastened together.

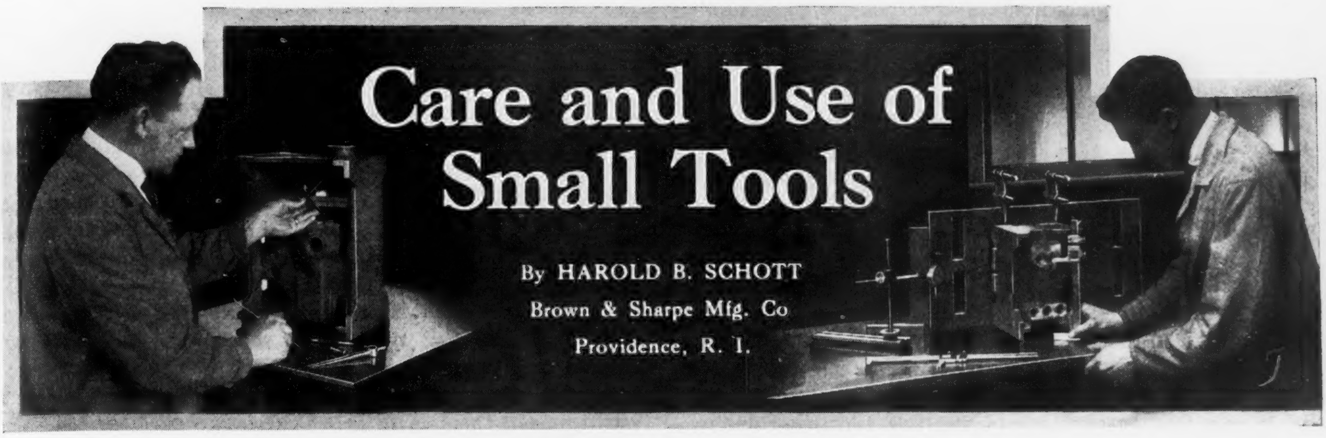
Next, a round core, 2½ inches in diameter by 21 inches long, was taken from the foundry stock cores. This core, as indicated at *d*, view *G*, was passed through the holes in the side of the box. Sand was then filled into the box, and the core finished in the usual way, the round core being withdrawn after the sand had been filled in. The hole left by removing the core was filled with molding sand to prevent the body core from collapsing. The core-box was next lifted away, leaving the core ready for the baking oven. After the body core was baked, the round core *d* was passed through the body core and pasted in place, thus forming a complete core of the shape and size indicated by the views at *A*.

The smaller core was made in the same box by locating the filler pieces *a* on each side of the box, as indicated in the view at *G*. In this case, the surplus sand at the top of the box was cut away or struck off with the strickle board *g*. Black sand was then filled in up to the top of the box, and struck off. The box was next rolled over on the drying plate, and the sand struck off from the upper side with the strickle board. After removing core *d*, the box was lifted away, leaving the core ready for the baking oven. The projecting core was pasted into the baked body core, as in the previous case.

In one hour from the time the order was received in the pattern shop, the core-box, together with its equipment, was on its way to the foundry. The time and labor saved in making the box as described, instead of making three complete half core-boxes, such as shown at *B*, was considerable. Instead of using a stock core *d* in molding the body core, a wood plug, such as shown at *e*, view *F*, could be inserted in the holes in the sides of the core-box. In this case, cores of the required length would be inserted in the holes left in the body core by the removal of plugs *e*, in order to form the complete core. A wooden mandrel, such as shown at *f*, which can be passed completely through the box, could also be used in place of core *d* when making the mold.

* * *

There are two principal steps in making malleable-iron castings. First, hard "white" pig iron, mixed with a proportion of steel and cast-iron scrap, is melted in a furnace and then run into the molds for the castings. Second, these "white" iron castings are cleaned and trimmed and then "heat-treated" by being packed in a mixture of powdered slag and iron oxide in large covered iron boxes, or "pots," placed in an annealing oven, slowly heated to about 1550 degrees F., held at this temperature and slowly cooled, the heat-treatment requiring seven days.



Care and Use of Small Tools

By HAROLD B. SCHOTT
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Approved Methods of Using Various Classes of Small Machinists' Tools, and Essential Points Regarding their Adjustment and Protection when not in Use

MACHINISTS' small tools may be divided into three groups according to their degree of sensitiveness and accuracy. The first group comprises those tools not used for actual measurements, and includes V-blocks, clamps, small vises, center-punches, scribers, plumb-bobs, etc. The second group includes tools that are used for comparative purposes or for transferring measurements, such as inside and outside spring calipers, dividers, surface gages, standard external and internal cylindrical gages, squares, spring depth gages, etc. Precision tools, or those used for obtaining actual measurements in inches or parts of inches, constitutes the third class, including rules, micrometers, combination squares, protractors, bevel protractors, and verniers.

Tools of the first group are ordinarily used in conjunction with those of the second and third groups as an aid in obtaining accurate measurements when laying out or machining work. V-blocks are made in pairs and are precision tools in that the sides are ground parallel and the V-grooves are carefully ground central and parallel to the bottom and sides. The fact that each block is made accurately in alignment with the other is a reason why these blocks should receive a certain amount of care in their use. The abuse of one or both blocks, by raising burrs on the surfaces or edges, is a sufficient cause to spoil their relative alignment and accuracy. Clamps, plumb-bobs, etc., are practically fool-proof, and only require protection from rust.

Points on Using Spring Calipers

Tools used for comparative purposes or for transferring measurements require more care and intelligence in their use, and in order to use these tools properly, much is dependent upon the "feel" or degree of sensitiveness employed. The degree of accuracy obtained in using inside or outside calipers depends entirely on the individual. Skillful mechanics can employ these tools with accurate results when working to close tolerances, while less skilled mechanics will have difficulty in maintaining the "roughing sizes." Variation in calipering work depends on the setting of the caliper and the individual's touch or "feel" in applying it.

In setting a caliper from a rule, it is essential that the eye be on a direct line with the caliper toe when taking the scale reading. A mistake sometimes made is that of springing calipers to make them fit. In sizing outside diameters, the calipers should be held at right angles to the axis of work, and the weight of the calipers should be sufficient to permit them to pass over the work, the amount of resistance felt determining the accuracy. Many machinists, when calipering turned work, stop the machine, hold one toe of the caliper against the under side of the work, pass the other toe across the top side, and carefully feel for the contact of the caliper with the work. This is a more common practice in using large calipers.

Inside calipering, in addition to the skill in "feel," is dependent upon keeping the caliper handle on the imaginary center of the hole, and the legs each an equal distance in from the edge. Considerable care must be exercised in making internal measurements, as it is easy to cramp the caliper and obtain an inaccurate measurement. In using standard external and internal gages, the same precautions as outlined for calipers should be observed. These gages are more substantially made than calipers, and consequently there is less tendency to spring, but by forcing or cramping gages, the accuracy of the measurement is impaired.

Machinists' try-squares are made extremely accurate, and although this tool is more or less fool-proof it well repays a machinist to keep his square in a case when not in use. In using a try-square, the face of the blade should be held square with the work being tested. The corners of the blade should never be used for testing for squareness. Abuses similar to those outlined for V-blocks impair the efficiency of a square, and caution should be observed to avoid burrs.

The value of a spring depth gage is dependent on the accuracy of transferring the measurement to a scale, so care in use, as previously outlined with regard to calipers, applies equally to this tool. A spring depth gage is a very handy addition to a machinist's kit for readily determining depths of small holes, recesses, shoulders, counterbores, etc.

Precision tools, although designed and manufactured to withstand reasonably hard usage, deserve considerably more care than they ordinarily receive. A good mechanic appreciates the fact that these precision tools, capable of measuring to 0.001 inch (and in some cases to 0.0001 inch) deserve the same care and consideration as any other sensitive mechanical contrivance. It is surprising the abuse these precision tools receive in the hands of some mechanics, and how quickly the same mechanics complain should their measurements deviate 0.001 or 0.002 inch.

The well-known combination square set is very useful for laying out work, and its adaptability and versatility is such that it is used extensively. In using a combination square set, the mechanic should take care to scribe the line as close to the rule as possible. In a properly constructed combination square set, the center head is made slightly off center (approximately 0.003 inch) to allow for the thickness of a scribed line.

Care and Adjustment of Micrometers

The adjustment of precision tools depends on their particular construction, and to describe the adjustment of each particular style and make of precision tool would require a lengthy article. However, as the micrometer is such a common form of precision tool, it is well to consider its care and use in detail.

A micrometer should be taken apart only when absolutely necessary, for any dirt or grit which might enter is very detrimental to its successful operation and injurious to the threads. In grinding rooms, it is an easy matter for abrasive to find its way into the screw, and rapidly reduce its accuracy. Hence the tool should be protected as much as possible.

In measuring, adjust the micrometer slowly into contact with the work to be calipered. Only a light pressure is required. If adjusted too forcefully, an inaccurate reading will result. Especially is this true of micrometers graduated to read to ten-thousandths of an inch, and the use of this type of tool should be confined to precision measurements as much as possible, as wear which would be of comparatively slight consequence in a micrometer that reads only to thousandths is perceptible and important in a tool of this class. Quite frequently such micrometers are insulated from heat. This is done by clamping wood to the frame or wrapping it with cloth or some other poor conductor of heat. It is well to remember, too, that the heat of the hand, the cutter, or the work will make a momentary difference in the reading. To avoid this, the tool should be kept in a place unaffected by heat. For extremely accurate measurements, the work and micrometer should be allowed to attain the same temperature. This is usually accomplished by letting them remain together on a surface plate or bench.

In oiling, only the best quality of a very light oil should be used, and this in a small quantity. A light sewing machine or gun oil is recommended for this purpose. Never use a heavy oil. The spindle should be removed, and the threads thoroughly cleaned with pure naphtha. When the tool is dry and free from any trace of naphtha, the oil should be placed on the threads and the spindle turned back, the oil working into the threads as it returns. A clean toothpick is very convenient for placing oil on the threads. Before oiling, clean the nozzle of the oil-can and shake out a few drops of oil through it to remove any dirt or dust. The oil must be clean.

With ordinary treatment, a micrometer caliper can be used a long time without adjustment. However, in case it should be necessary, means have been incorporated in its design for adjustment to compensate for wear of the screw and also for correcting the reading when the micrometer is set at zero.

Fig. 1 shows how wear or play can be taken out of the screw of a popular style micrometer. The sleeve, with the spindle, is removed and placed where it will be free from dust, preferably on a clean piece of paper. The slots in the tapered nut can then be seen, and this nut is adjusted by using the special wrench furnished with the micrometer. Since that part of the hub containing the tapered threads is split, a very slight turn reduces the diameter of the thread enough to make the screw snug. The illustration shows the sleeve removed and the wrench in hand for making the adjustment. After the adjustment is made, the sleeve should be rolled between the palms of the hands to insure the threads working smoothly.

Fig. 2 shows the means of adjusting the micrometer to obtain the correct zero reading, should the anvil or spindle become worn. It is necessary to have the measuring surfaces of the anvil and spindle clean, and a good way to clean them is to bring these two surfaces together on a clean sheet of paper and then draw out the paper. Screw *A* should be turned to the left just enough to compensate for the backlash in the screw; only a slight adjustment is required usually in resetting the anvil. After making this adjustment, the micrometer should be tested for its zero reading, the measuring surfaces having first been cleaned. If necessary repeat the adjustments until the zero reading is exactly correct; however, care should be taken not to move the anvil too far, for if this is done, the entire operation must be repeated to eliminate backlash. Screw *B* should not be touched unless it is impossible to move screw *A*, and then *B* should be loosened very carefully, for it is likely to turn the anvil when moved. Screw *B* is merely a binding screw. The illustrations Figs. 1 and 2 show the micrometer held in a vise having leather-faced jaws, and although not necessary, a vise so equipped gives a firm support without marring the tool, and reduces the effect of heat from the hand.

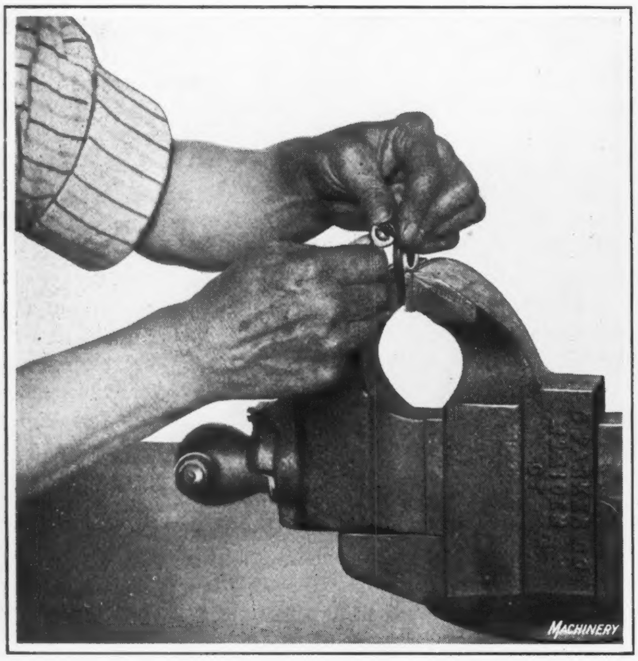

Fig. 1. Adjusting Micrometer to compensate for Wear in Screw

Fig. 2. Adjusting Micrometer to obtain Correct Zero Reading

In using a micrometer depth gage, particular care should be observed to set the micrometer screw so that the leverage exerted by the screw does not raise the base of the depth gage from the work. This is a common fault which can be readily overcome by firmly holding the base of the gage on the work (see Fig. 3) and adjusting the screw slowly and carefully. The flat blade, usually employed in a vernier depth gage, is much easier to set, as it is necessary to hold the base on the work with one hand and push the blade down to the part to be measured with the other, thus overcoming any tendency to lift the base.

Owing to the peculiar nature of the work measured by the thread micrometer, it should not be used in originating

or generating standard thread plugs any more than a micrometer caliper should be used in establishing a standard cylindrical plug. Screw thread micrometers should, however, give very close measurements for comparative purposes. A screw thread micrometer graduated to ten-thousandths inch is not recommended. After using a thread micrometer, and before putting it away, the spindle should be separated from the anvil face by withdrawing it a few turns. This is also good practice in using any form of micrometer caliper.

Mechanics should see that all forms of vernier calipers are kept absolutely free from dust or dirt, as grit working under the slide causes scratch marks that will eventually mar the graduations. Verniers should be held as lightly as possible, especially when measuring holes, as in this case the accuracy is dependent on the sense of feel, the same as when using an inside spring caliper.

In using a vernier height gage, as, for example, for laying out jigs or fixtures from a surface plate or machine bed and taking measurements from a plug, the top of the jaw of the height gage should always be passed under the plug, as shown in the right-hand view of the heading illustration. The jaw should never be passed over a plug, as this has a tendency to lift the base of the height gage from the surface plate or machine bed, and thus give an inaccurate reading. Good height gages are made with the under side, or bearing surface of the base, slightly relieved, so that as much friction as possible may be eliminated. Thus when passing the jaw under a plug, a very sensitive "feel" may be obtained.

Fig. 3. Proper Method of holding Micrometer Depth Gage when taking a Measurement

A toolmaker's bevel protractor is perhaps one of the most difficult of tools to manufacture, as it is absolutely necessary to have lines that are consistently of the same widths, both on the vernier and on the protractor. It is also a tool that requires much care in setting, as its accuracy is dependent on the lines on the protractor matching exactly with those on the vernier. A good operator takes the precaution of having someone else check up his setting, in order to note any deviations due to differences in eyesight. Setting the tool in a proper light is essential, so that no shadows will be thrown on the graduations. Most mechanics prefer to face the light, having it shine directly down on the reading.

Machinists having a natural bent for mechanical work, usually take considerable pride in their tools, and protect them well when not in use. Such precaution is well repaid, for they find their tools always in first-class shape to use, and accurate in measurements. Furthermore, the life of a tool, when properly cared for, is practically unlimited. In putting tools away for any length of time, they should be thoroughly cleaned (the use of first quality naphtha is recommended for this purpose) and then covered with a coating of oil to prevent rust. If naphtha is used, the tool should be free from all traces of it before the oil is applied. It is a good idea to wrap tools in oil paper also, as this excludes dust, dampness, etc. The boxes in which tools usually come packed will be found convenient for laying them away.

INTERNATIONAL EXPOSITION IN PHILADELPHIA

The plans for the Sesqui-Centennial Exposition in Philadelphia in 1926 have been quite definitely formulated. The purpose of the exhibition is threefold: (1) To mark the 150th anniversary of the signing of the Declaration of Independence; (2) to show the progress of the world, particularly in the fifty years since the Centennial Exposition was held in Philadelphia in 1876; and (3) to create a closer understanding and foster good will between the nations of the world. The exposition will open April 30, 1926, and close November 13.

Among the great exhibition buildings will be a large automobile hall, an airplane building, an electrical palace, and a hall of commerce and industry, in which the progress of the last fifty years will be shown by contrast. For example, the original Corliss engine will be exhibited side by side with the modern steam turbine; a locomotive of 1876 will be shown in contrast with the electrically driven locomotive of 1926, and a hand-plow of 1876 in comparison with the tractor of 1926. This idea of contrast will be carried out throughout the entire exhibit. In the machine tool field some very interesting exhibits can be provided in this connection. A Palace of the Press will also be one of the features; here the growth of the modern newspaper, the periodical press, and engineering and trade journals will indicate the progress made in this field.

In connection with the exhibition, an international engineering congress will be held, to which delegates from all the important engineering organizations of the world will be invited. This engineering congress is organized under the auspices of the American Society of Mechanical Engineers, the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Institute of Electrical Engineers, the Federated American Engineering Societies, and the Engineers' Club of Philadelphia.

* * *

INACCURACY IN MACHINING EARLY STEAM ENGINES

An interesting sidelight was thrown on the development of machine tools in an address by Dexter S. Kimball, dean of the College of Engineering, Cornell University, and past-president of the American Society of Mechanical Engineers, before the Philadelphia Local Section and the Machine Shop Division of the society. It was mentioned that the primitiveness and the inaccuracy of the machine tools in use when Watt began to build his steam engines are almost unbelievable. We find him complaining of one of his steam cylinders that "at the worst place the long diameter exceeds the short by 3/8 inch," and there is much other evidence that indicates similar crudity in all machine processes. The development from these crude beginnings to the modern standards of accuracy and output is something of which every engineer may well feel proud. Wilkinson's boring machine solved Watt's difficulties so that Boulton writes of a 50-inch cylinder that "does not err the thickness of an old shilling in any part."

Position of Thread-cutting Tool and its Effect on Thread Form

By WILLIAM S. ROWELL

As screw threads are dimensioned in a plane that intersects the center line of the work, tools made to these dimensions and set in the same plane will cut a thread of similar dimensions; but if for any reason the position of the tool is shifted from the axial plane, the form of the thread will be altered an amount depending upon several factors. The position of the tool is particularly important when cutting square threads, especially if the lead of the thread is large in proportion to the diameter of the screw.

Position of Tool for External Thread Cutting

As an illustration, assume a 4-inch outside diameter square thread with a groove having a width and depth of 1 inch and a lead of 8 inches. For this thread groove, the angles of inclination to the plane of the center line are approximately 57 degrees 31 minutes at the outside diameter, and 38 degrees 8 minutes at the inside diameter of the groove. Such a thread groove with a section of a relieved tool is shown at *A*, Fig. 1. This tool, however, would not be practical, because the left-hand side has excessive rake and the chips would tend to wedge between the tool and the side of the groove along the right-hand side, owing to the negative rake. To overcome the objectionable features, the rake is usually balanced by using a tool which is set normal to the thread groove as shown at *B*. It will be seen that a much narrower tool must be used in this position than in the plane of the center line in order to cut a groove of the same width.

In balancing the rake the tool is usually set normal or at right angles to the thread groove at half depth, or at the so-called pitch line. It will be understood, of course, that the angle varies from the outside to the inside diameter of the groove, so that the setting of the tool is necessarily a compromise. In this case, the thread groove angle, measured from the plane of the center line, is 49 degrees 41 minutes at half depth.

A section of this thread in the plane *a–b* normal to the groove at half depth is shown at *C*, which indicates that the thread tool must have the shape shown at *C* in order to cut a thread having a square form in the plane of the center line. In other words, the form of tool illustrated by the shape of the groove at *C* is the only one that will cut a square thread when the top of the tool is set in the plane *a–b*.

If a tool of square form were used, the groove produced would have the shape shown at *D*. The normal square section is shown in dot-and-dash lines for comparison. A section of this groove in the plane *a–b* has the form shown at *E*, where the normal thread groove in this section is also shown in dot-and-dash lines. The dot-and-dash lines *f* and *g* show the normal thread groove, and the full lines show the widened groove that a full-width tool would cut if set in plane *a–b*. A tool of normal shape, 1 inch wide, would, if set in plane *a–b*, also cut the bottom of the groove concave, thus removing part of the bolt core, unless the end of the tool were given a concave form to prevent this. Usually, however, this concavity at the bottom of the thread groove would be slight, and therefore would be allowable.

If the thread depth is slight in proportion to the diameter, and the angle of inclination of the thread groove to the plane of the center line is large, the distortion of the groove

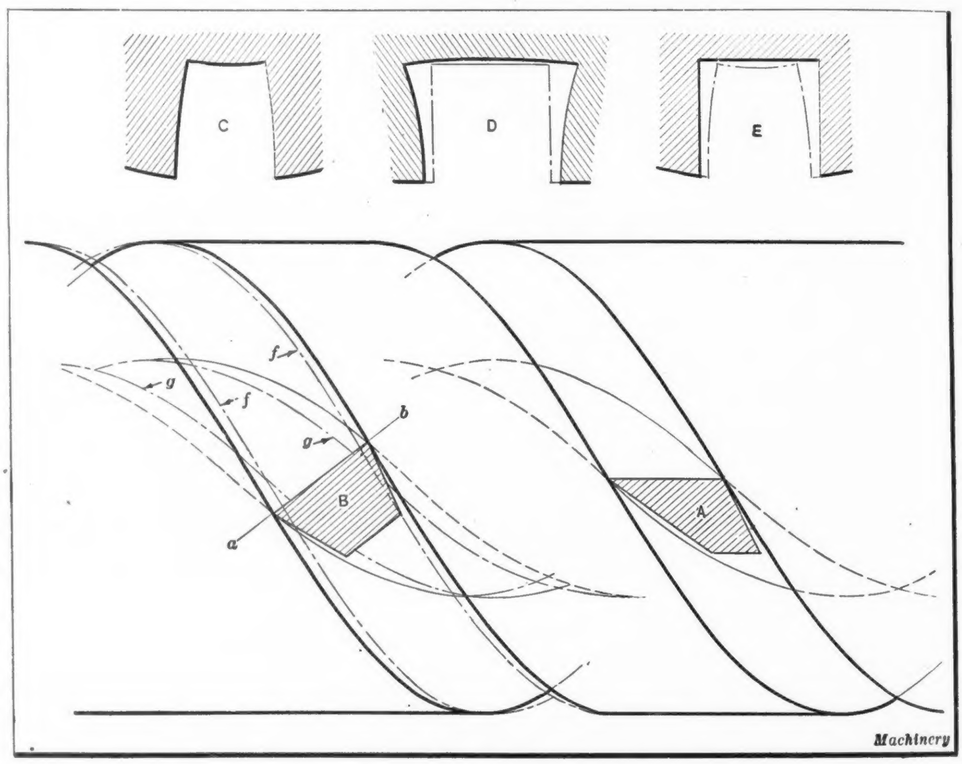

Fig. 1. Diagram illustrating Variations in Thread Form resulting from Changes in the Position of Thread Tool

produced by balancing the rake is negligible. But if the thread is deep and the angle comparatively small, this distortion is an item which should be considered. When the rake is balanced in the usual way, the distortion of the groove form is much greater at the inside diameter than at the outside diameter of the groove. This is because of the rapidly diminishing angle of the groove inclination as the center of the work is approached. Hence, it is evident that the tool should be set normal to the groove at some point below the half depth position, especially in extreme cases, in order to reduce, as far as possible, the distortion of the thread groove in the plane of the centers.

Distortion Produced in Cutting Internal Threads

As most externally threaded parts are designed to mate with internally threaded parts, the effect of balancing the rake of the tool for cutting internal threads will now be considered. It will readily be seen that a change in posi-

tion of the cutting edge of the tool will distort an internal thread groove in a nut, the same as in the case of an external thread. Since it would be impracticable to cut a thread of rapid lead in a nut, with the top of the tool set in the plane of the centers, it is essential to balance the rake. If a tool of normal shape and size is set at right angles to the side of the groove at the half depth position, the resulting distortion of form will result in a poor fit between the nut and bolt, even though the latter be perfect, but as these distortions tend toward a loose fit because of widening the groove in both bolt and nut, the inaccuracy is in many cases more readily excused.

As to remedies, if it were a simple case of an increase in the width of grooves, this could be overcome by narrowing the tools a sufficient amount; but as seen by sections *C*, *D* and *E*, the tool should also have convex sides and a concave or convex nose (depending on whether it is an internal or an external threading tool) to produce thread grooves with straight line sides and bottoms in the plane of centers. The amount of narrowing and also the convexity can be calculated, but the resulting curves would be very difficult to follow except by a process of generating.

When this subject was discussed twenty years ago, C. Higgins described a possible method of generating such tools by mounting the stock for the external tool in a lathe tool-

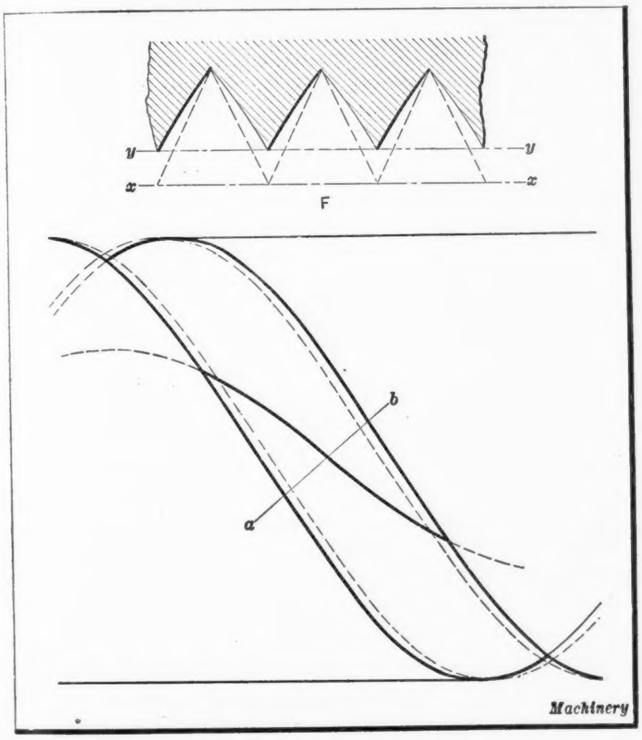

Fig. 2. Diagram showing Thread Groove of V-form and Distortion Possible under Extreme Conditions

post, and forming it by the action of tools set in a bar revolving between the lathe centers while the carriage moved in the direction and at the relative speed proper for the lead to be cut. Similarly, the stock for an internal tool would be mounted as for internal threading, while being acted on by cutting tools extending inward from a bracket fastened to the faceplate of the lathe.

It should be understood that the generating tools in both cases are radial elements of the thread to be cut, and are placed the same distance from the center of rotation as the sides of the thread to be cut. The noses of such tools may be similarly generated by cutting tools with edges that are elements of the bottom of the thread grooves—either external or internal: These tools would be mounted on a bar in the lathe for the nose of an external tool, and on a bracket on the faceplate for the nose of an internal tool. In each case the cutting tool is the same distance from the center of rotation as the bottom of the thread to be cut. The flat upper face of the stock from which the tools are generated would in this case be 49 degrees 41 minutes from the horizontal plane of the lathe centers.

Distortion of Thread Grooves having Angular Sides

It is evident that any form of thread will be distorted by balancing the rake of the tool, but that square threads show the most distortion for a given lead, diameter and depth of groove in external work. This is because the thread groove is wide at its inside diameter where distortion is naturally the greatest. The distortion produced in a 60-degree external thread would be comparatively slight, as the narrow width at the inside diameter would tend to eliminate widening of the thread groove where widening is greatest in a square thread. In the case of an internal 60-degree thread the widening is zero at the outside diameter and maximum at the inside diameter because of its width where distortion is naturally greatest.

Fig. 2 shows an external thread groove of the same width, depth, and lead as the square thread we have been considering; but instead of being of square section, it is almost a 55-degree V-form. This form is selected in order to establish a comparison between square thread and a V-thread, since for this angle the thread is as wide as it is deep. With a tool ground to the proper angle, and the cutting edges in the plane of the centers, the normal groove shown by the dotted lines at *F* would result. Shifting the tool to position *a–b* would result in a thread groove about 7/32 inch wider than normal at the outside diameter, with slightly concave sides in the plane of the centers, and this increase of width would reduce the depth of the thread from line *xx* to line *yy*. This reduction amounts to about 9/32 inch, the outside diameter being reduced 9/16 inch.

It is not to be supposed that anyone would by any chance produce such a thread groove as illustrated at *F*, even though the angle of the thread to the plane of the centers was as small as 49 degrees 41 minutes, but it is well known that troubles in thread forms are often encountered and not thoroughly overcome because of a lack of knowledge as to just what causes the trouble.

What has been said about the distortion of the external thread represented by the diagram Fig. 2 applies in principle to internal threads, in connection with which the most difficulty is encountered, especially in the V-form of thread. Thus, if an internal thread groove corresponding to the external thread groove represented in Fig. 2, were cut with a tool of normal shape, set at right angles to the groove at the mid-position, the thread depth would be reduced as shown at *F* for an external thread. The sides of the internal thread, however, would be convex instead of concave. What has been said regarding the difficulties connected with forming a theoretically correct tool for square threads of rapid lead and the way to overcome them applies to V-threads as well.

* * *

SCHOLARSHIPS FOR INDUSTRIAL TEACHERS

The state of New York is offering twenty-five scholarships of $1000 each for men who wish to become industrial teachers, to be awarded to qualified trade and technically trained men. Those awarded these scholarships will spend one year at the Buffalo State Normal School, preparing to teach their subjects in the public vocational schools of the state. At least five years' all-around experience as journeyman is required in the trade or occupation that the applicant expects to teach. In the machine shop field, the following occupations are covered by the terms of the scholarship: Machine shop work; automobile repairing; machine drafting and design; electrical drafting and design; electrical construction, repair and operation; and sheet-metal working. Further information relating to these scholarships may be obtained by applying immediately to the State Department of Education, Albany, N. Y.

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AN OPPORTUNITY FOR THE A. S. M. E.

How can a large and influential engineering society like the American Society of Mechanical Engineers become most useful to the members who are interested principally in the design of machine shop equipment and the management and output of machine shops? In the general mechanical engineering field including steam engines, steam turbines, hydraulic turbines, gas engines and pumping machinery, a great variety of research work has been accomplished that has proved of the highest value to the industries. As a result of this work, the cost of power has been materially reduced and many economies have been made possible.

In the machine shop field, the work of the society, with a few notable exceptions, has been less conspicuous, although the investigations of Fred W. Taylor and Carl Barth on the art of cutting metals were as scientific and far-reaching as any that have been made in other branches of mechanical engineering. In practical machine shop work, there is great need for fundamental research; but unfortunately, all such work involves experiments conducted at considerable cost, as investigations based on well-known theories, such as form part of general mechanical engineering practice, would produce no satisfactory results.

If it is not practicable for the society to serve those who are engaged in the design and economical operation of machine shop equipment by placing on record the results of research work in that branch of engineering, there is another way in which it can become useful to them. An accurate record of good current practice is greatly needed. For example, consider the drawing of sheet metal. No fundamental research work of any importance has been done in connection therewith; but information describing the best practice of firms or engineers who are experienced in that field would be of great value. Some engineers must have collected data relating to the possible reductions in drawing sheet-metal work, the frequency of annealings, and the power required for producing drawn shells, which, recorded in papers read before the society, would be helpful to many members engaged in machine shop work.

Similar information on drilling, tapping, and cutting off metals with rotary saws and power hacksaws, would be equally valuable; and also definite data on the newer cutting metals, stellite, diamond alloy, Chesterfield metal and others of similar qualities. It is not necessary that all these data be based upon exhaustive experiments and research. They are valuable if they merely record what has been found by experience to represent good, everyday shop practice—if they place on record the best practice of the best shops for the benefit of all members.

In the machine shop field, such information made available through papers presented before the society would parallel in value the analytical researches on the properties of steam in the power field. The work in the shop cannot be subjected to such definite laws and rules as the equipment under the direct control of the power plant engineer, because the human element enters into shop work to a much greater extent. But an engineering society can serve the latter field equally well by adapting itself to shop requirements and recognizing that theoretical analyses in the one field are no more important than the records of practical operations in the other. The value of each must be measured according to the conditions prevailing in the industry that is served.

THE DEVELOPMENT OF GEAR GRINDING

Less than ten years ago taps ground in the thread were unknown to the trade; today they are made commercially in considerable quantities. A still later development is that of grinding the teeth of gears to an accurate tooth shape; but this method also is rapidly becoming a commercial process, and several machines are now on the market for grinding gear teeth. Only a few years ago such refinement in gear manufacture was considered unnecessary; today it is general practice for high-grade automobiles.

One interesting development of the gear grinding process is that highly accurate gears can be produced with ground teeth without appreciably increasing the cost over gears whose teeth are merely cut to shape with some form of hob or cutter. When gear teeth are to be ground, they can, of course, be roughed out more cheaply, and the loss of gears in the heat-treating process is smaller, because the distortion in hardening is corrected by the grinding process. A large percentage of gears for high-grade automobiles were thrown into the scrap heap after hardening, when the teeth were not ground. This waste was costly, but formerly there was no known method of avoiding it.

The gear tooth grinding machine saves many gears from being scrapped, and when this item is considered, together with the reduced cost of cutting the teeth, it will be found that the additional grinding operation adds but little to the total cost of the gears. For these reasons the gear grinding machine is destined to occupy a place alongside other important types of machine tools.

* * *

DOES YOUR FUTURE LIE BEHIND YOU?

In a New York savings bank there is a poster headed, "Someone is Banking the Money that you Waste." Changing the wording, but not the fundamental idea, the statement "Someone is Filling the Job You Lost by Wasting Your Time," would apply to thousands of men in the shops who would have better jobs today had they taken the trouble to prepare themselves for more important positions.

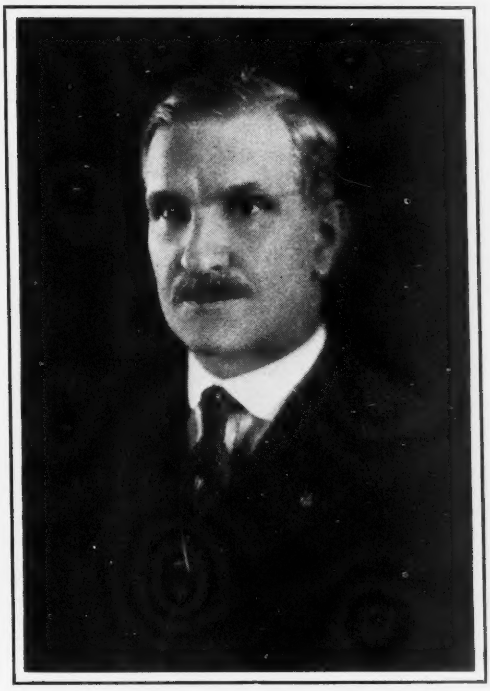
Few young shop men today realize how difficult it was for those who started in the machine shop even as recently as twenty years ago, to acquire a mechanical education. At that time there was less than one-tenth of the practical mechanical literature now published. Then there was, for example, not one comprehensive work published on the subject of jigs and fixtures, there was no book dealing with the principles of the design and production of small tools, there was no handbook which specialized on information for the designer and shop man in the machine shop industry. The facility with which knowledge can be acquired today in machine shop practice and machine design makes it possible for any young man of average ability to prepare himself for a better position within a few years.

There is now a library of carefully prepared books, covering almost every subject in the mechanical field, from which all the principles of machine design and shop practice can be learned, supplementing the practical experience obtained in the office, drafting-room or shop. An ambitious student is offered every facility to acquire in a few years a fund of knowledge from technical literature that ten or twenty years ago could have been obtained only from shop instruction given by some of the older mechanics.

American Gear Manufacturers' Convention

THE outstanding feature of the seventh annual meeting of the American Gear Manufacturers' Association, held at the Hotel Cleveland, Cleveland, Ohio, April 19, 20, and 21, was the great amount of data presented in the reports of the society's standardization committees. Apart from the Society of Automotive Engineers, no association in the industrial field has paid as much attention to standardization in its field of activity as the gear manufacturers. The larger part of all the sessions was devoted to reports by the standardization committees. The association now has nearly 100 member companies. At the annual meeting one new company was elected to membership—the Braun Gear Corporation, Brooklyn, with Jacob Braun, executive member.

F. W. Sinram, president of the Van Dorn & Dutton Co., Cleveland, Ohio, and for the last six years president of the association, welcomed the members to Cleveland. He made a brief reference to his pre-convention message that had been sent to the members, in which he called attention to the important part the American Gear Manufacturers' Association plays in the industries, and showed how, through the association's work, gear-making has been recognized as a separate and independent industry. Attention was also called to the fact that for the first time in the history of the association, which was founded in 1917, we are in a period of normal times, present conditions being more favorable to a healthy progress than at any time since the association was formed.



George L. Markland, Jr., New President of A. G. M. A.

The purposes and aims of the American Gear Manufacturers' Association are twofold—commercial and technical. As stated in the constitution, its objects are to discuss subjects of interest and value to the industry in which the members are engaged; to improve the conditions in the industry; to collect and distribute statistics and information of value to the members; to standardize methods of design, manufacture, and application of gearing; and to promote a spirit of cooperation among the membership that will result in improving production methods and increasing the application of gears.

Probably the most important of the activities so far undertaken is the standardization work. The association is now cooperating with a number of other societies in work of this kind. A definite program for the technical standardization activities has been laid down, and as the times and conditions are now more favorable for the progress of standardization work than ever before, all the members were requested to take an active part in this work. There is evidence on every hand of great interest in the work so far accomplished, and the reports presented at the meeting indicate that within the near future some important standardization may be adopted by the gear manufacturers in conjunction with other leading societies in the industrial field—the American Society of Mechanical Engineers, the Society of Automotive Engineers, and the American Engineering Standards Committee.

Standardization Reports

B. F. Waterman of the Brown & Sharpe Mfg. Co., Providence, R. I., chairman of the general standardization committee and vice-president of the association, presented two reports, one relating to the general standardization work within the association, and the other with regard to the work carried on in cooperation with the American Engineering Standards Committee. The work of the different committees was reviewed, and the extensive scope of the work at present being carried forward was outlined. E. W. Miller of the Fellows Gear Shaper Co., Springfield, Vt., presented a report relating to the cooperation of the Gear Manufacturers' Association with the American Society of Mechanical Engineers in regard to research on the strength of gears.

Separate reports were presented by the committees on spur gears; bevel and spiral bevel gears; herringbone gears; nomenclature; worm-gears; sprockets; electric railway, mill, and mine gears and pinions; composition gearing; differential gearing; metallurgical standardization; industrial relations; inspection; commercial standardization; and uniform cost accounting.

Strength of Spur Gears

The spur gear committee, of which F. E. Eberhardt of the Newark Gear Cutting Machine Co., Newark, N. J., is chairman, presented recommendations, the purpose of which is to provide a simpler method of calculating the strength of spur gears. The method is based on the Lewis formula, but provides for simpler factors and introduces a list of constants that facilitate the work. The report states that the horsepower a gear will transmit depends on the quality of the material, accuracy of the tooth spacing, accuracy of the tooth form, quality of the finish, rigidity of the shafts, bearings and housings, and accuracy of the shaft alignment.

A gear that is supported on only one side should be made with a comparatively narrow face. A good rule is to make the face not over the American Gear Manufacturers' Association's recommended standard = 10 ÷ D.P.

Gears should always be made strong enough; that is, they should be good for at least 25 per cent more horsepower than the rated load. If the drive is subject to a known overload, or a probable overload, the gears should be made strong enough for the full overload plus a margin of safety. This means that for such service as heavy rolling-mill work, crushers, reciprocating pumps, and similar duty, the gears should be designed with such an overload factor in mind. The actual overload may equal 250 per cent of the rated load.

When pinions with less than 18 teeth are used, the service may call for stronger teeth than the 14½-degree standard. In such cases, it is advisable to consider the 20-degree standard depth tooth, or a 14½-degree tooth with long addendum. Pinions with low numbers of teeth may be used for slow movements and heavy work, but they are not so desirable for pitch-line velocities above 800 feet per minute.

On motor drives and for ordinary industrial gearing, where ideal conditions do not prevail, it may be necessary, for quietness, to use non-metallic pinions, when the pitch-line velocities exceed 800 feet per minute. If rawhide, cloth, bakelite, or similar non-metallic material is not strong enough for the load, a combination of strength and quietness may be obtained by a laminated construction, using alternate sheets of steel and non-metallic material riveted together.

When gears are mounted rigidly and supported on both sides, well made gears may be run in oil at pitch-line velocities of 2000 feet per minute, both gear and pinion being made of metal.

The spur gear committee also presented a report covering definitions of spur gear terms—a nomenclature for spur gearing for the consideration of the members.

Bevel and Spiral Bevel Gear Standardization

The bevel and spiral bevel gear committee, of which F. E. McMullen, of the Gleason Works, Rochester, N. Y., is chairman, in cooperation with the nomenclature committee, submitted a report on nomenclature for bevel gearing, defining not less than eighty-seven different terms employed in connection with gearing of this type. This work will be carried to its conclusion in conjunction with the American Engineering Standards Committee. The definitions adopted by the committee are made broad enough to apply to gears other than those of the bevel type, when the same terms are used in various kinds of gearing. However, it is difficult to make a definition perfectly clear, when so broad in its application, and for this reason it may be more practicable to have the definitions differ, in some cases, for various types of gearing.

In addition to the nomenclature, the committee submitted as recommended practice for future design that part of the Gleason Works bevel gear system which was presented at the Chicago meeting of the association last fall, and which was published in full in November, 1922, MACHINERY. This recommended practice was adopted by the association.

Worm-gear Standardization

The worm-gear committee, of which J. C. O'Brien of the Pittsburg Gear & Machine Co., Pittsburg, Pa., is chairman, presented a comprehensive progress report for the design of worm-gearing, together with tables and formulas. This report is an attempt to effect a compromise between the commercial, practical, and theoretical requirements in the design and manufacture of worm-gearing. In studying the problem of standardizing worm-gearing, it was found advisable to divide the gearing into groups, and the group covered by the present recommendation is defined as follows: Linear pitches, 1/4 to 2 inches, single to quadruple thread; gear ratios, from 10 to 1 to 100 to 1. This includes worm-gearing required for general commercial uses where the gearing is furnished without bearings or housings, and does not include gearing with the axes at other than 90 degrees. The recommendations incorporated in this report are as given in the following:

(A) That the thread form to be regarded as standard will be the form produced by a straight-sided milling cutter having a diameter not less than the outside diameter of the worm nor greater than 1 1/4 times the outside diameter of the worm, the sides of the cutter having an angle of obliquity of 14 1/2 degrees in the case of single- and double-thread worms, and an angle of obliquity of 20 degrees in the case of triple- and quadruple-thread worms.

(B) That single- and double-thread hobs may be fluted parallel to the axis.

(C) That triple- and quadruple-thread hobs should be fluted normal to the thread angle reckoned from the outside diameter of the hob.

(D) That the following linear pitches be regarded as standard for this group: 1/4, 5/16, 3/8, 1/2, 5/8, 3/4, 1, 1 1/4, 1 1/2, 1 3/4, and 2 inches.

The fact is recognized that in the case of worm-gearing a longer period of transition from present haphazard methods of designing to standard methods may be expected, and in order that the best results may be obtained from existing facilities, the following recommendations are made for the use of existing hobs:

For wheels engaging with single- and double-thread worms, the width of face should not be greater than the chord of the worm outside circle which is tangent to the worm pitch circle, plus one-half the linear pitch.

For wheels engaging with worms having triple or quadruple threads, a face width of 1/4 circular pitch less than the above is recommended.

For the use of existing hobs, it is recommended that the outside diameter of worm-gears be made the following amounts larger than the pitch diameter.

For wheels meshing with single- and double-thread worms:

$$\text{Outside diam.} = \text{pitch diam.} + 3.5 \times \text{addendum}$$

For wheels meshing with triple- and quadruple-thread worms, where the pressure angle is 20 degrees or greater:

$$\text{Outside diam.} = \text{pitch diam.} + 3 \times \text{addendum}$$

For wheels meshing with triple- and quadruple-thread worms, where the pressure angle is less than 20 degrees:

$$\text{Outside diam.} = \text{pitch diam.} + 2.75 \times \text{addendum}$$

In every case a radius at the edge of the wheel rim equivalent to 1/4 circular pitch is recommended.

In connection with this report, complete formulas were presented for the design of worm-gearing. Those interested in the subject can obtain blueprints covering these formulas from the secretary of the association, T. W. Owen, Room 107, 2443 Prospect Ave., Cleveland, Ohio.

Sprocket Wheel Standards

The sprocket committee, of which C. R. Weiss of the Link-Belt Co. is chairman, presented a very complete report, which is also expected to become the standard of the Society of Automotive Engineers and of the American Society of Mechanical Engineers. When finally approved by these two societies, in conjunction with the gear manufacturers, there will be a recognized standard for sprocket wheels that completely covers the various phases of sprocket wheel design.

Other Standardization Reports

The composition gearing committee, of which F. S. Sorensen of the Cincinnati Gear Co., Cincinnati, Ohio, is chairman, presented a report on gears made from rawhide or other non-metallic materials. The report includes tabulated information which will be of value to the designer in aiding him to lay out pinions of proper proportions with the least amount of calculation. The tabulated data submitted in connection with the report is a simplification of the charts that had formerly been accepted by the association, presented in a more convenient form for ready reference.

The differential committee, of which S. O. White of the Warner Gear Co., Muncie, Ind., is chairman, as well as the railway gear and pinion committee, of which W. H. Phillips of the R. D. Nuttall Co., Pittsburg, Pa., is chairman, both presented progress reports accompanied by tabulated data.

Papers Read before the Meeting

A number of papers of unusual interest to both gear manufacturers and gear users were read at the meeting. E. C. Smith, chief metallurgist of the Central Steel Co., Massillon, Ohio, read a paper on "What Does the Microscope Tell Us?" in which he showed a number of screen pictures of photomicrographs, and indicated the significance of the grain structure and the appearance of the fracture.

E. J. Lees of the Lees-Bradner Co., Cleveland, Ohio, read a paper on "Grinding and Measuring Involute Gear Teeth," in which the company's measuring machine was demonstrated and the theory on which it is based, explained. Wilfred Lewis, of Philadelphia, Pa., spoke on gear-testing machines, explaining in considerable detail different types of gear-testing machines designed in the past, and outlining the principles upon which a highly developed form of gear-testing machine should be based.

Col. L. P. Ayres, vice-president of the Cleveland Trust Co., Cleveland, Ohio, spoke on "How Long Will Prosperity Last?" He pointed out that at the present time we are enjoying a degree of industrial activity that has never before been equaled, not even during the war. This high-pressure activity may be expected to last until late in the year, when it is likely that there will be a gradual decline to more normal business.

An address that aroused a great deal of interest among the gear manufacturers was that by K. L. Hermann of the Studebaker Corporation, who spoke on "Tooth Forms of Automobile Gears after Cutting, Hardening and Grinding." In his address, Mr. Hermann showed by charts how the accuracy of tooth forms and tooth spacing may be tested, and which method of gear-cutting is likely to give the most accurate results. Another paper of considerable interest was presented by S. P. Rockwell, consulting metallurgist, 65 Highland St., Hartford, Conn., dealing with the determination of the grade of steel by observing the characteristics of the spark when a sample is pressed against an abrasive wheel. This paper, together with spark pictures indicating the form of spark resulting from different grades of steel, will be presented in a coming number of MACHINERY.

Other papers of interest presented before the convention were an address by O. C. Kiehne of the Van Dorn Electric Tool Co., Cleveland, Ohio, on "Practical Value of Cost Accounting," and one by A. F. Cook of the Fawcus Machine Co., Pittsburg, Pa., on "Hit-and-Miss of Cost Accounting."

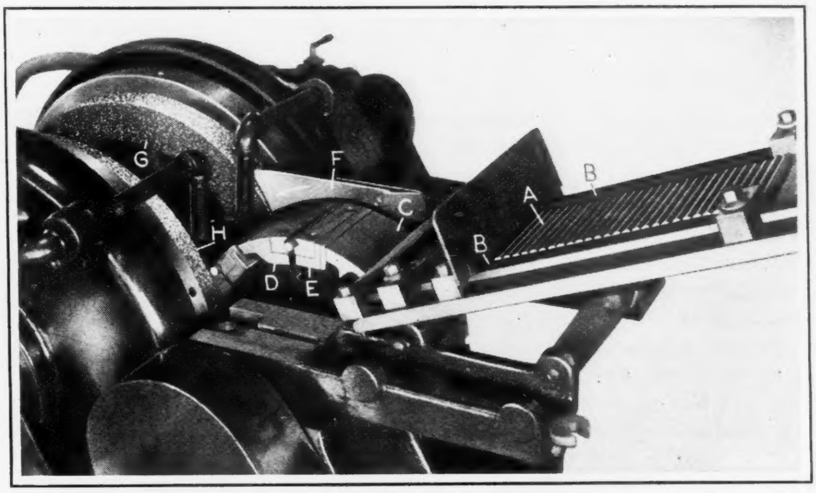
At the meeting, six members were elected to the executive committee, as follows: A. W. Copland, Detroit Gear & Machine Co.; C. B. Hamilton, Jr., Hamilton Gear & Machine Co.; R. P. Johnson, Warner Gear Co.; George L. Markland, Jr., Philadelphia Gear Works; B. F. Waterman, Brown & Sharpe Mfg. Co.; and Arthur E. Parsons, Brown-Lipe Gear Co. George L. Markland, Jr., was elected president to succeed F. W. Sinram, who has held this office ever since the association was formed. A. W. Copland was elected first vice-president; B. F. Waterman, second vice-president; and C. F. Goedke, treasurer. In consideration of the services rendered the association during his presidency, Mr. Sinram was elected honorary president. S. P. Rockwell of Hartford, was appointed consulting metallurgist of the association.

In connection with the meeting, an exhibition was held under the auspices of the metallurgical committee, of which C. B. Hamilton of the Hamilton Gear & Machine Co., Hamilton, Ontario, is chairman. This exhibition included a complete metallurgical laboratory for a machine shop, showing means both for chemical analysis and for the testing of hardness and strength.

VALVE STEM GRINDING ATTACHMENT WITH MAGAZINE FEED

The valves that control the ports through which the gases enter and leave the combustion chamber of an automobile engine may be of one-piece construction, or the head and the stem may be rough-machined or forged separately and then joined together by welding. It is the practice of one manufacturer, in following the latter procedure, to grind the ends of the valve stems preparatory to welding them to the heads. The magazine attachment shown in the accompanying illustration is employed for grinding the ends of the stems on an automatic grinding machine built by the Badger Tool Co., Beloit, Wis., which was described on page 403 of January MACHINERY.

Referring to the accompanying illustration, it will be seen that the machine is set up to grind both ends of the valve stems. It would seem unnecessary to grind more than one end of the valve stem, as the welding operation is performed only on one end, but it has proved cheaper to grind both ends, so that either end may be welded to the head. Thus the welder loses no time in determining which end of the stem is to be joined to the head.



Magazine Grinding Machine Attachment for grinding Ends of Two-piece Valve Stems

The stems to be ground are placed in a feed-chute, as shown at *A*. The guide strips *B* can be adjusted within certain limits to accommodate stems of different lengths. The stems are fed by gravity into the openings between the jaws in the work-carrying head or drum *C*. There are several sets of these jaws in the drum. One set consists of a fixed member, such as shown at *D*, and a pivoted or movable jaw *E*. The movable jaw is opened and closed by means of a cam as the drum revolves in the direction indicated by the arrow. The jaws are, of course, in the open position when opposite the delivery end of the feed-chute.

Let it be assumed that the machine is in operation and that a valve stem has just dropped into the opening between a pair of jaws. As the drum continues to rotate, it carries the valve stem between two sheet-metal guides, one of which is shown at *F*, the other having been removed to give a better view of the drum. The guides serve to locate the stems in the jaws so that the grinding wheels *G* and *H* will remove the same amount of metal from each end of the work. After the work has been thus centered, the cam-actuated jaw *E* closes on the work, and holds it firmly in place while it passes between the grinding wheels.

When the work has been carried around out of contact with the grinding wheels, the pivoted jaw opens and permits the valve stem to drop into a chute, which carries it to a box placed at the front of the machine. The open jaw then picks up another piece of work, as it passes the delivery end of the chute, and the operation is repeated. Each set of jaws operates in the same manner, and production is continuous as long as the chute is kept supplied with work. It will be noted that the chuck jaws are fitted with V-blocks. These blocks are removable, so that work of different lengths and diameters can be accommodated by simply substituting different sets of blocks. The production is thirty pieces per minute.

The British Metal-working Industries

From MACHINERY's Special Correspondent

London, April 12

ALTHOUGH most engineering industries are experiencing ups and downs, the tendency as a whole is quite definitely in an upward direction. Competition for new business is very keen, and at present manufacturers are satisfied with meager profits. Prices of most metal-working commodities have stabilized, and any change invariably means an increase.

The Continental demand for blast furnace coke and coking fuels has turned what was a scarcity into a famine, and although some areas report an increased demand for British iron and steel to replace the imports that the Continent has stopped supplying, the scarcity of fuel makes delivery a very uncertain quantity.

The Machine Tool Industry

The machine tool industry shows signs of acceleration, although inquiries are still out of proportion to orders. Buying is fairly general in character, but immediate or very early delivery is a stipulation that has to be met if orders are to be obtained. Buyers are coming to the conclusion that prices are stabilizing and that increases may be expected at any time. As only a few makers now have stocks of any magnitude, there is more building activity in order that inquiries can be met with the promise of quick delivery. Makers of power presses, turret lathes, and brass finishers' lathes, are among those who are feeling the first movements toward a steadier flow of business. The activity of the railway shops is reflected in the purchase of machine tools.

Small tool makers continue to be comparatively active, the healthy conditions of the automobile and motorcycle industries being a salient cause of a steady small tool consumption. At the moment the total output of small tools is estimated to be within measurable distance of the pre-war average capacity.

Overseas Trade in Machine Tools

During February the exports of machine tools continued to show the wide fluctuation that has characterized these returns for many months. February shows a heavy drop as compared with January, the export tonnage for the month falling from 1337 to 1033, the corresponding value being £157,500 and £111,250. Imports rose from 276 to 358 tons, but fell in value from £33,830 to £33,673. While the export value per ton fell quite substantially—from £118 to £108—the import value per ton came down from £123 to £94. Although it would be absurd to base any generalization on one month's returns, there can be little doubt that the number of high-grade machine tools must have fallen.

As in January, exports in February showed a prominence over imports in all classes of machine tools, both in value and in tonnage. The heaviest items of export were lathes, planing and shaping machines, and heavy simple type machines, such as plate-cutting and plate-bending machines, steam hammers, etc. Lathes also figured prominently among imports, but were evidently chiefly lower priced machines, since the average value per ton was only £86 5s.

Railway and General Engineering Fields

Several orders for locomotives have been placed recently. It is evident from quotations submitted that prices do not constitute a hindrance to placing of orders, as, in reply to an inquiry from the Indian railways for eighty-two locomotives, the prices quoted by not less than seven British manufacturers were lower than those received from the Continent. British makers also offered much quicker delivery.

At the same time, railway demands for all classes of products and material are not developing to the extent expected two or three months ago, and it is thought that several projects that would have given a considerable amount of work will now be postponed until the fall.

Now that the regrouping of the railways is an accomplished fact, the question of rates revision is being brought up. Today railway rates are about 75 per cent above the pre-war level—a figure which compares unfavorably with the general level of wholesale prices. A request has been made to the railways by the Federation of British Industries that the rates should be reduced without delay to 33 1/3 per cent above the pre-war level.

In the constructional engineering field the present increased prices of iron and steel prevent the quoting of acceptable prices. In the Manchester district, builders and other constructional yards are slack. Tube makers are very busy on substantial foreign orders. Many steel works and laboratories of technical institutions are increasing or renewing their testing equipment.

The Automobile Industry

The majority of automobile manufacturers have sufficient orders to keep them going, and some of the leading firms are obtaining new business at a rate that exceeds their production rate. Although the small light types of cars are most prominent among the orders received, there continues to be a fair demand for medium class touring cars; but makers of higher quality cars are none of them working at anything like full capacity. The export trade in automobiles is disappointing. Makers of automobile fittings and equipment are mostly working at full capacity, and motorcycle and bicycle makers are increasing their output.

Materials

The demand for iron and steel is good, but it is almost impossible to obtain delivery owing to fuel shortage. Material prices went up suddenly during March in the Sheffield area. Increases are not confined to ferrous metals, aluminum and copper also having risen in price.

The development of stainless ferrous metals is proceeding rapidly. In Sheffield, considerable progress is being made with the production of stainless castings, and the ultimate success of such a process should inevitably open up an enormous field, particularly as it does not promise to be prohibitive in cost. Already some intricate shapes have been successfully cast.

A new form of combined iron and steel was described by Dr. Longmuir before the Birmingham Metallurgical Society. This appears to be much ahead of the steel-faced iron that has been used extensively in the past for anvil faces, press tools, hammer heads, and so on. One feature of the process is that the interpenetration of the two metals is perfect; and another is that steel of very high carbon which will carry the keenest cutting edge is obtainable. Such steel would be difficult to harden in long, thin bars or blades, and the risk from water cracks would be considerable. The greatest advantage is, perhaps, that blades of wood-planing and other machines, made from this material, will be safe to use, as, if the steel should crack, it would not fly, and there would be no danger at the highest speeds.

GERMAN INDUSTRIAL CONDITIONS

From MACHINERY'S Special Correspondent

Berlin, April 12

Of approximately 10,085,000 workmen in Germany, about 2,710,000 are employed in the mining, iron and steel, and metal-working industries, and hence it is apparent that the economic stability of Germany depends to a great extent upon these industries. The serious effect of the French occupation in the Ruhr and other sections on industrial Germany will be understood when it is remembered that 800,000 of the workmen engaged in the industries mentioned live in the occupied districts. Perhaps a better realization of the industrial importance of the occupied territory will be obtained by considering the mining industry alone. Of an estimated 252,000,000,000 tons of coal deposits in Germany, approximately 90 per cent is under French and Belgian control at present, and in 1922 the coal mined in the Ruhr alone represented 92.6 per cent of that mined in the whole country. Germany was formerly a coal-exporting country, but it is now necessary to import coal; approximately 9,538,000 tons having been imported during 1922. The center of iron and steel production is in the occupied territory as well.

Although these losses will be keenly felt in the future, the consequences of the Ruhr invasion are not so seriously felt at present as one might suppose. According to reports from establishments employing 1230 workmen, conditions are about the same as prior to the occupation. The question of selling inside the occupied districts constantly assumes a more serious aspect. However, as stocks had been sold out just before the invasion, and the various establishments are busy on repair and maintenance of equipment in addition to production, employment will probably not drop suddenly during the next few months.

The question naturally arises as to how long industrial Germany can survive without assistance from the occupied regions. Other large industrial centers, such as Saxony, Hanover, and Berlin, are in a position to take over the bulk of the foreign business, and serious scarcity of iron and steel can be avoided for a long period by increasing the production in non-occupied districts. Large quantities of iron scrap are being imported from Russia in exchange for other goods, and large contracts have been made with Swedish and Spanish interests for iron ore. Iron ore can also be imported from Luxemburg, Austria, England, and the United States. As to the shortage of coal, serious difficulties are not expected for a year, because the big industrial plants, on the average, have from four to six weeks' supply, and coal is constantly being imported from England, Upper Silesia, and Czechoslovakia.

The Machine-building Industries

The machine-building industries show a slight decrease in activity, but the condition of the machine tool branch is satisfactory. Machine builders are suffering somewhat from the scarcity of iron and steel.

From a commercial point of view, the results of the Leipzig Fair, which was held March 4 to 10, inclusive, were disappointing. Although there were 166,000 visitors, the majority of potential purchasers expected a reduction in prices. The show-room space of the Association of German Machine Tool Builders had been increased about 22,000 square feet this year. This association is in its twenty-fifth year, and has about 400 members. During 1922 only about 1600 tons of machine tools were imported into Germany, as against 540 tons in 1913, while about 78,200 tons were exported as against 90,300 tons in 1913. Exports of machine tools during January, 1923, were about 20 per cent of the monthly average for 1913, which indicates that Germany is not doing a great export business in this field.

Living Conditions

Wages and living costs rise constantly with the continued depression of the mark. At the beginning of March, the weekly wage of a skilled workman, expressed in marks, was about 1630 times the wage of pre-war times, while the wage of an unskilled workman was about 2050 times the wage of pre-war times. Living costs have risen even more, being about 2650 times the level of 1913-1914. Employment is satisfactory, statistics from labor unions showing that out of a membership of 5,800,000 only about 4.4 per cent are out of employment.

The Exchange Situation

The value of German exports for 1922, expressed in gold marks, dropped to one-third of the value of pre-war years. In consequence of the tremendous drop in the value of the mark during past months the paper mark retains importance only as a means of immediate payment. The dollar has become by far the most important factor in establishing the relation of the paper to the gold mark. The members of the Association of German Machine Tool Builders were the first to use the dollar in their accounts. Business of the last few years is characterized by big paper-mark profits, both in production and commerce, but paper-mark profits have proved to be losses. Profits made in selling goods are usually not sufficient to secure the same quantity of goods again.

The character of all the economic and political factors makes it impossible to draw any conclusions as to the future. Political events have resulted in a closer understanding between Germany and Russia. The principal difficulty in trading with Russia is the question of credit. England is in a position to allow longer credits and, therefore, enjoys a far greater trade with Russia than Germany.

* * *

PREVENT FACTORY FIRES

The annual fire loss in the United States amounts to nearly $500,000,000, the per capita loss in 1921 being $4.24, an unparalleled figure not even approached in any other country. The states with the greatest fire loss in proportion to population were Delaware, New Hampshire, and California. The lowest rate was found in Vermont. Carelessness with matches and smoking was the leading single cause of fires in 1921. At least 65 per cent of the fire loss could have been prevented by the exercise of proper precautionary measures and the realization on the part of everyone of the danger of carelessly handling matches and throwing away lighted cigars and cigarettes. In addition to the property loss, an even greater loss was sustained in the 15,000 lives that were lost in fires during the year. The greatest care should be exercised, especially around shops and factories in regard to matches, because the oil-soaked floors, waste, and other combustibles furnish an additional danger which everyone should guard against.

* * *

MACHINE TOOL SITUATION IN HOLLAND

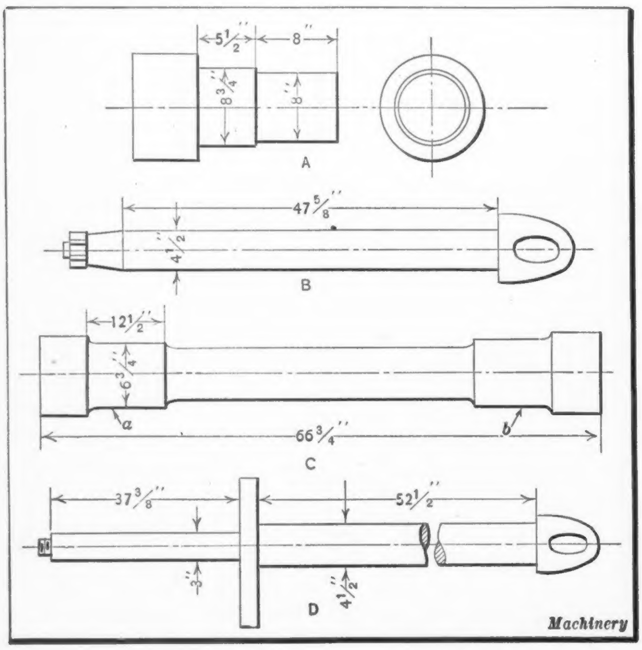
Germany controlled the trade in machine tools, as well as in other types of machinery, in Holland during 1922. American machine tools, which in former years were imported to a considerable extent, constituted but a small part of the 1922 imports. In spite of the fact that during the first half of 1922 the prices of American machine tools were lower than they had been for years, the prices of German machines were still lower, and the difference in price was too great to permit American machines to be sold. On the whole, there was a large decrease in all Dutch imports of machinery on account of the general business depression. The present difference in price between American and German machines is from 20 to 40 per cent.

GRINDING LOCOMOTIVE PARTS

In many railroad shops, grinding has replaced the older method of turning and rolling as a means of machining various parts. A comparison of the results obtained by the two methods in machining three important locomotive parts is given in this article in order to show the saving in production time made possible by grinding. The grinding equipment employed for the work described was made and installed in a railroad shop by the Norton Co., Worcester, Mass.

Grinding Locomotive Crankpins

No record of the production time for the locomotive crankpin shown at *A* in the illustration previous to the adoption of the grinding method is available, so that a comparison of the production rates obtained by the old and new methods in this particular case cannot be made. This pin is made of steel, and must be straight within limits of 0.00025 inch and have a good journal finish. The pin is rough-turned previous to grinding, about 0.035 inch of stock being allowed



Locomotive Parts finished to Size on Grinding Machine

for the latter operation. A Norton 24- by 4- by 5-inch, grain 24 C grade K grinding wheel, running at a speed of 940 revolutions per minute, is used for this job. The total time required for the rough-turning and grinding operations on the two dimensioned sections of the work is thirty minutes.

Grinding Piston-rods

Piston-rods of the type shown at *B*, which have been worn in service, are readily refinished by grinding in much less time than is required by the older method of turning and rolling. For this work, a 24- by 4- by 5-inch grinding wheel grain 24 C, grade K, is used. The speed of the grinding wheel in this case is 940 revolutions per minute. The piston rod, when finished, is required to be straight within limits of 0.0005 inch. Approximately 0.030 to 0.060 inch of stock is removed by grinding. The production time for the grinding method is thirty-five minutes as compared with from one to two and one half hours for the turning and rolling method.

Operations on Locomotive Axles

The time required to machine the locomotive axle *C* by the turning and rolling method was from four to five hours. The production time on this part has been reduced to thirty minutes by rough-turning and then finish-grinding to size. The grinding operation is performed only on the two larger bearing surfaces *a* and *b*. About 0.035 inch of stock is removed in the grinding operation, and the finished surfaces are required to be straight within limits of 0.0005 inch. A 24- by 4- and 5-inch grinding wheel, grain 24 C, grade K, is used, which is run at a surface speed of 5900 feet per minute.

Refinishing Worn Piston-rods

Previous to the introduction of the grinding method, it required from four to five hours to turn and finish-roll a worn piston of the type shown at *D*, so that it would again be fit for service. This work is now accomplished in fifty-eight minutes on a grinder equipped with a 24- by 4- by 5-inch grinding wheel, grain 24 C, grade K. The ground sections of the work are required to be parallel within limits of 0.0005 inch. From 0.030 to 0.060 inch of stock is generally required to be removed. For this job, a wheel speed of 940 revolutions per minute is employed.

* * *

CONVENTION OF NATIONAL METAL TRADES ASSOCIATION

The National Metal Trades Association held its twenty-fifth annual convention on April 18 and 19 at the Hotel Astor, New York City. During the first session there were the usual appointments of convention committees, reports of officers, and the opening address by the president, W. W. Coleman. In his address Mr. Coleman dealt in part with the labor situation, industrial education, and the economic importance of immigration.

During the various sessions a number of prominent men addressed the association on topics of particular interest and importance to the metal trades. The question "Shall We Close our Gates to the Immigrant?" was discussed by Magnus W. Alexander, managing director of the National Industrial Conference Board, New York City. "The Old Government and the New Industry" was the subject of an address by the Hon. W. L. Huggins, Justice of the Kansas Supreme Court, Topeka, Kans. Hon. Arthur R. Baxter of Indianapolis spoke on "Business Men and Politics"; and "The Law of Supply and Demand" was discussed by Dr. G. W. Dyer, Professor of Social Science, Vanderbilt University, Nashville, Tenn. Robert S. Binkerd, vice-chairman of the Committee on Public Relations, Eastern Railroads, New York City, spoke on "What is the American Railroad Question?" Dr. J. T. Holdsworth, vice-president of the Bank of Pittsburg, gave an address on "Business and Government." At the convention banquet, Laurence Lyon, former member of Parliament, addressed the convention on "The New Diplomacy."

The following offices were re-elected for the coming year: President, W. W. Coleman, Bucyrus Co., S. Milwaukee, Wis.; first vice-president, J. B. Doan, American Tool Works Co., Cincinnati, Ohio; second vice-president, Paul C. DeWolf, Brown & Sharpe Mfg. Co., Providence, R. I.; treasurer, J. W. O'Leary, Arthur J. O'Leary & Son Co., Chicago, Ill

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TRACTOR MEETING OF S. A. E.

The Society of Automotive Engineers held its annual tractor meeting at the Auditorium Hotel, Chicago, on April 19. The all-purpose type of farm tractor was discussed at one of the sessions, and constructive engineering data based on the Nebraska tractor tests were presented at another. Automotive transportation was dealt with in a meeting held by the society in Cleveland, April 26 to 28, at which papers were read relating to the field of the motor truck in railroad terminal cartage service; the economic control of truck operation; results of tests on motor truck rear axles; and the motor bus for passenger transportation.

Metal Patterns for the Foundry

By J. F. HINES, Hines Pattern & Mfg. Co., Cleveland, Ohio

THE cost of machining castings is influenced greatly by the quality of the castings. To obtain maximum production rates, it is necessary to have castings that can be cut or machined easily. In addition to this, they must be uniform in size and so dimensioned that a minimum amount of metal will need to be removed in the machining operations. In order to obtain accurate castings, it is obviously necessary to provide patterns that will produce accurate molds. The metal patterns described in this article were developed to do this, and they have proved very satisfactory, not only as regards accuracy, but also from the point of view of rapid production.

Aluminum Double-faced Cast Match Plate Patterns

For many classes of work it has been found that there is no better form of pattern than the double-faced match plate. A pattern of this type has all the advantages possessed by the so-called "gate of patterns" in that it allows a number of castings to be poured simultaneously, and in addition it provides a simpler means of making the molds. Double-faced match plates can be used either where the sand is rammed in the flask by hand, where a manually operated squeezer is employed, or where a power-driven jolt squeezer is used in the foundry. This type of pattern will usually be found to give the maximum results obtainable with any of these methods.

The cope and drag, or top and bottom sides, of a double-faced metal match plate are shown in Fig. 1. It will be seen that this consists primarily of what is known in the foundry as a "gate of patterns"; that is to say, there is a series of patterns gated into one or more runners, so that each mold provides for making a number of castings. In this case provision is made for making thirty-two castings at a time. It will be noticed that there is a series of patterns on one side of the match plate corresponding to thirty-two half sections of the pieces to be cast. A second series of patterns, corresponding to the other thirty-two half sections of the pieces is located on the other side of the match plate; thus the half patterns for the thirty-two castings are supported by the match plate. The match plate is provided with eye-holes at each end to receive the guide pins on the flask.

In using a double-faced match plate for molding, the method of procedure is to put the match plate between the two halves of the flask. Sand is then rammed into the drag side of the flask, after which bottom boards are placed over the sand to prevent it from shifting when the mold is turned over. The bottom boards are made small enough to fit inside the drag flask. Sand is next rammed into the cope side of the flask. A cope board provided with a cup or button at the point of sprue is then placed on the sand, and the cope and drag are squeezed together. The cope is next lifted off the match plate after which the match plate is lifted off the drag. After the necessary hand work has been done in finishing the two halves of the mold, the cope side is placed on the drag, and the mold is ready to have the molten metal poured into it.

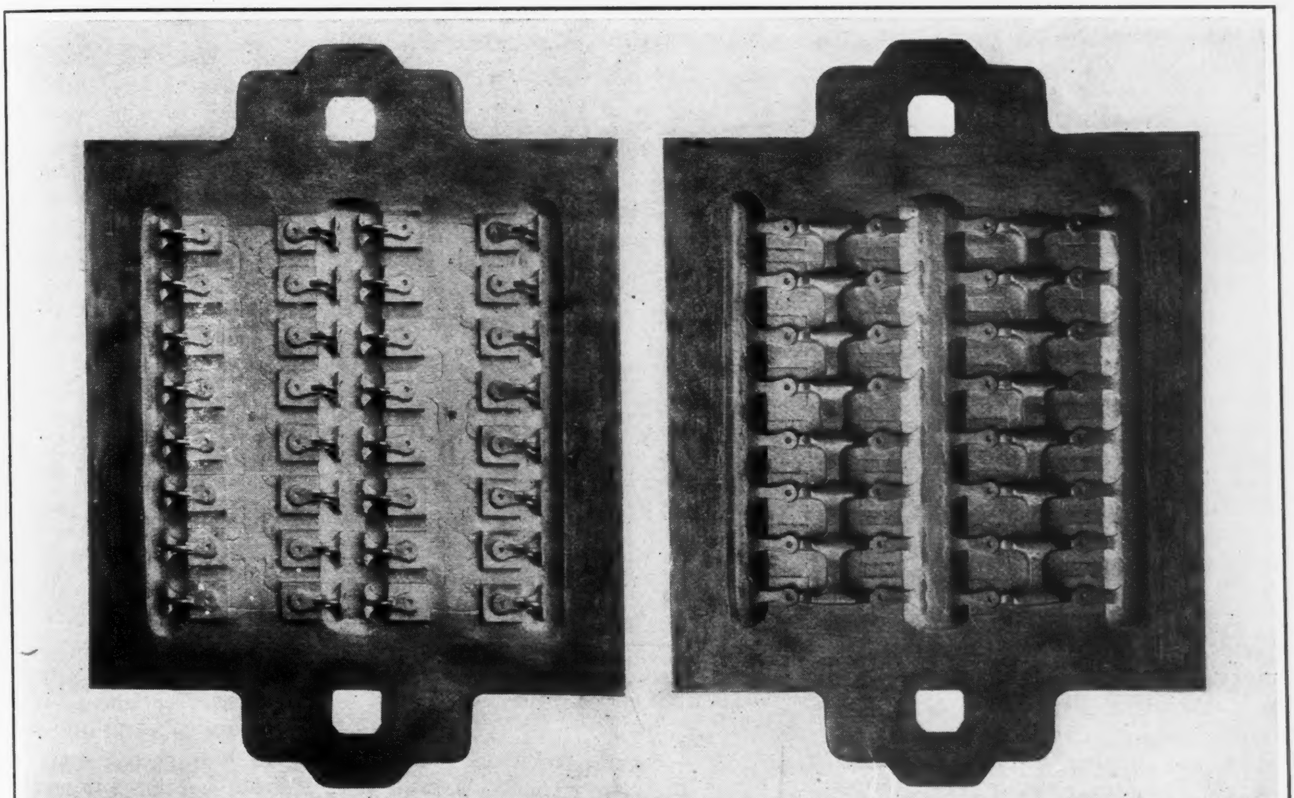


Fig. 1. Double-faced Match Plate Pattern which provides for casting Thirty-two Pieces at a Time

To those who are not familiar with patterns of this kind, it may not immediately be apparent how the two halves of the mold are produced. For the benefit of such readers, attention is first called to the fact that the guide pins that hold the cope and drag in alignment also pass through eye-

holes in the match plate. Bearing in mind that the two parts of each pattern unit are split on the parting line of the pattern, with each half at opposite sides of the plate, it will be apparent that the presence of the match plate between the cope and drag exerts no influence in making the mold, beyond constituting a carrier for the two halves of the patterns mounted on it. The cope and drag sides of the mold are made under conditions that assure their registering perfectly when the match plate is removed and the two halves of the mold are put together.

How a Double-faced Match Plate Pattern is Made

The starting point in producing a double-faced match plate pattern will vary according to the nature of the pattern. In this connection, attention should be called to the fact that a pattern of this type may provide for pouring anywhere from one up to a large number of castings in a single mold. Let us first consider a case similar to that shown in Fig. 1, where the match plate carries a number of pattern units. In such a case, the first step is to make a master pattern of one unit with the gate attached to it, as shown at *A*, Fig. 2. If this pattern is of a form comprising flat surfaces and regular shaped curves, it will be made of metal in order to take advantage of the convenience with which the surfaces can be finished on standard machine tools. But if the pattern is of irregular shape, it will be made of wood.

The pattern is then sent to the foundry, where it is used in the regular way to make molds for producing about six white metal castings. At *A* is shown the preliminary pattern, and at *B* a gate of six patterns produced by soldering the white metal castings to a gate. The purpose of this intermediate step is to facilitate the work of molding and casting the thirty-two units required to make the complete gate of patterns shown at *C* and *D*, which is used in casting the finished match plate. By the use of the gate *B*, molds are made to pour the required number of castings, and these are then cut off from their gates so that they can all be assembled into a single unit, as shown at *C* and *D*.

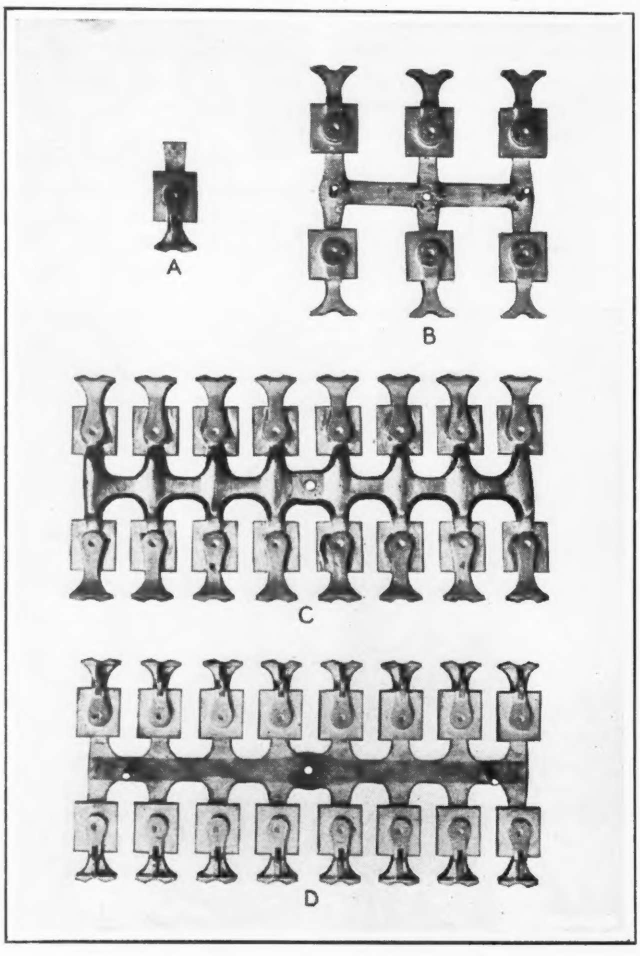


Fig. 2. (A) Master Pattern; (B) Gate of Six White Metal Patterns used in making Pattern Units; (C) and (D) Gate of Patterns used in making Double-faced Match Plate Patterns

Mounting the Pattern Units on the Gate

After the pattern units have been cast from white metal, according to the method just described, the gates are cut off close to the runner. The next step is to mount all the units on a single runner. In doing this work, it is of the utmost importance that each pattern be accurately mounted, because any lack of accuracy in alignment would make it impossible to obtain an accurate mold from this section of the pattern. After the runner has been made, each pattern section and its gate are set up with the runner on an accurate surface plate and carefully blocked in place, so that assurance is obtained that each pattern is in accurate alignment. The pattern units are then soldered to the runner, thus producing the gate of patterns shown at *C* and *D*.

Casting the Match Plate

A gate of patterns of the form described could be used in the foundry for making castings of the required form. As a matter of fact, gates of patterns are used for this purpose in certain foundries, but the degree of efficiency attained through their use in making molds is not as high as with a double-faced match plate. The best practice is to make double-faced match plates out of aluminum, because that metal is hard and rigid enough to give satisfactory service in the foundry; at the same time it has the advantage of being one of the lightest known metals, and as a result the handling of large patterns does not involve an unnecessary expenditure of physical effort by the molders. In making the match plate, the gate of patterns is used in exactly the same way as it would be in the foundry for molding castings that would later be sent to the machine shop for finishing.

The cope and drag sides of the mold are made in the usual way; but after this point has been reached, it is necessary to make provision for casting the match plate between the two sections of the pattern. For this purpose, strips of metal of the thickness desired are laid around the edge of one-half the flask in which the mold is made, and then the mold is built up with sand, a section being left around the cavity of the same size and shape as the match plate to be produced. When this additional work has been done, the cope and drag halves of the mold are put together, and the metal is poured in, with the result that a casting is produced having the two halves of the pattern with a match plate between them. When the work is skillfully done, the match plate comes from the mold in such a condition that very little subsequent hand work is required to prepare it for use in making molds for the production of commercial castings.

Making Simple Double-faced Match Plates

When it is desired to make a double-faced match plate pattern with only one or two pattern units mounted on the plate, the method of procedure in making the pattern is not nearly so complicated. In such instances, the master pattern is made of metal or wood, according to which is the most convenient procedure. The selection of material for making the master pattern is governed by its form, as previously stated. This pattern is used to make a mold, and the cope and drag sides of the mold are then separated by the use of metal strips and the addition of sand in the manner previously described, after which the aluminum is poured into the mold to produce the match plate casting.

For many classes of work, a double-faced match plate is regarded as the best form of pattern for use in the molding

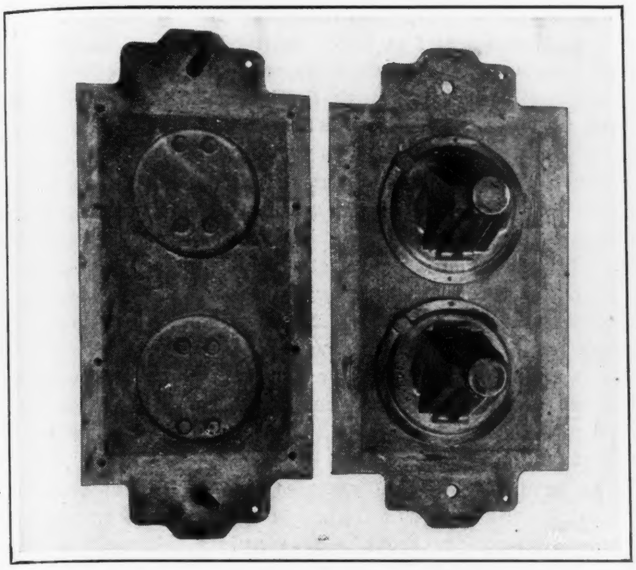


Fig. 3. Cope-plate and Drag-plate Patterns for Water Heater Pedestal

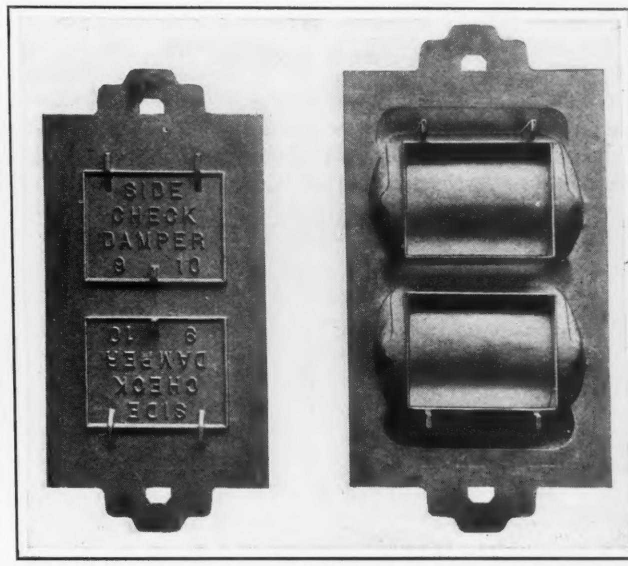


Fig. 4. Patterns for Check Damper Door and Door Frame for a Furnace

shop; but there is one limitation in the use of such patterns, namely, that the making of each mold involves four handlings before it is ready to receive the molten metal. To avoid such lost motion, some foundries make use of what is known as cope-plate and drag-plate patterns. Such patterns are shown in Figs. 3 and 5. It will be apparent that they are of the same general form as the double-faced match plate, except that the cope side and drag side of the gate of patterns are cast on independent plates.

Making Cope-plate and Drag-plate Patterns

The procedure in making these patterns is similar to that followed in making the match plate type. The master pattern is made of wood or of metal, as the case may be; and if a large number of pattern units is to be mounted on a single plate, the necessary number of white metal castings are made from the master pattern and soldered to a gate.

The gate of patterns is then sent to the foundry for use in making molds for the cope plate and the drag plate. These molds are produced in the usual way, but after the regular mold has been finished, both the cope side and the drag side are built up in the manner previously described, and then each half of the mold is provided with a blank mate; that is to say, the cope is fitted with a blank drag, and the drag with a blank cope. Then by pouring metal into either of these half molds, the resulting casting will consist of a plate having a gate of half patterns attached to it.

The advantage of using patterns of this type is that the cope plate and the drag plate are mounted on separate molding machines, arranged to operate in such a way that after the sand has been rammed by power, the pattern is lifted from the mold by the machine or by hand. After the necessary hand finishing, the two sides of the mold are put together. The accurately located guide holes in the cope plate and pins in the drag plate of the pattern assure proper registering of the two halves of the mold when they are assembled. In making molds by this method, there is only one handling of each half of the mold, as compared with four handlings of the complete mold produced with a double-faced match plate pattern. As a result the fatigue factor is cut down to a minimum, and men employed in making the molds are able to maintain a constant rate of output during the entire working day.

On either the double-faced match plate pattern or the cope plate and drag plate type of patterns, provision may be made for the use of a power vibrator for loosening the pattern from the sand, after the sand has been rammed into the flask and the work of making the mold has progressed to the point where the pattern is to be withdrawn. The use of this device not only increases the rapidity with which this part of the work can be accomplished, but also insures the making of more perfect molds.

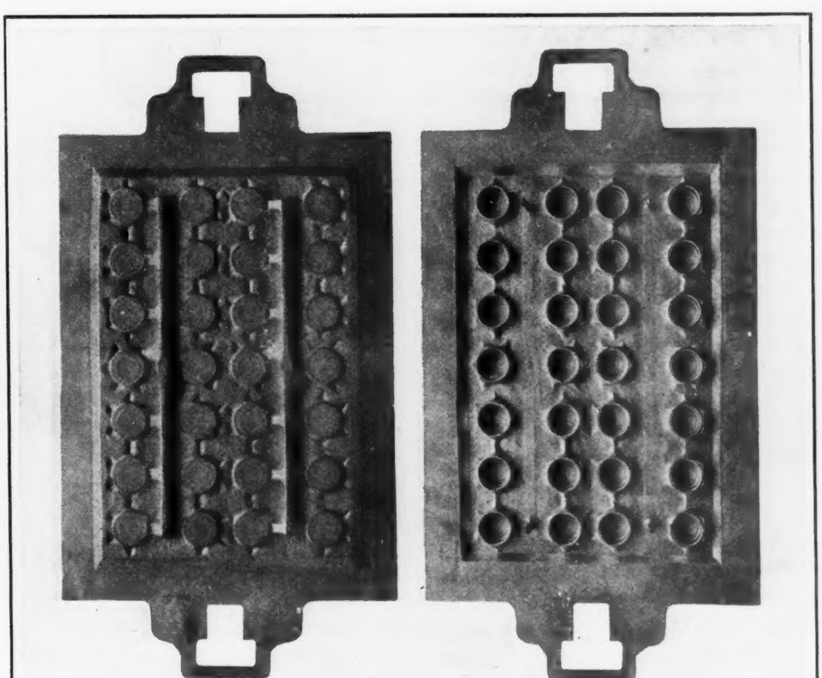


Fig. 5. Cope-plate and Drag-plate Patterns used in casting Brass Nuts for Pipe Unions

* * *

An international aeronautic exhibition will be held at Gothenburg, Sweden, from July 20 to August 12, under the auspices of the Royal Swedish Aero Club. Flying contests, in which more than thirty airplanes from different nations have already been entered, will be held on August 4 to 12. It is also planned to hold an automobile exhibition in the same city during May, June and July, in connection with the Tercentennial Exposition celebrating the three-hundredth anniversary of the founding of the city.

LAPPING FOUNTAIN PEN POINTS

By JOHN A. HONEGGER

The lapping machine shown in Fig. 2 is one of a series of machines recently built for a concern engaged in the manufacture of fountain pens of the type shown in Fig. 1. Previous to the construction of these special machines, all

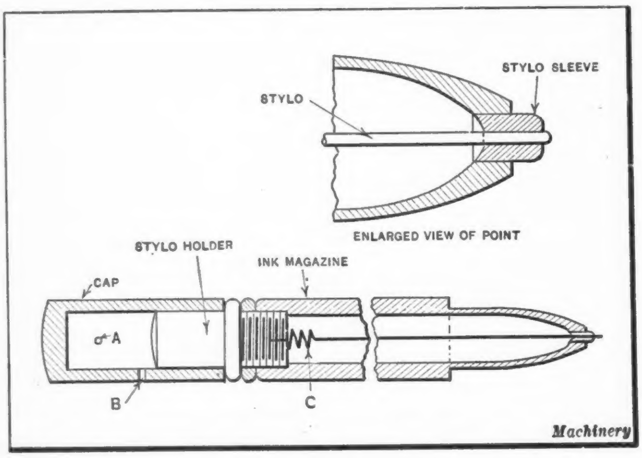


Fig. 1. Sectional View of Fountain Pen and an Enlarged View of Point lapped by Machine shown in Fig. 2

operations on the pen were performed by hand. The cap, stylo-holder, and ink magazine are of hard rubber, and are now turned and bored in automatic machines with special tools. The two holes *A* and *B* in the cap are drilled on a two-spindle drilling machine, one spindle being in a horizontal position and the other in a vertical position. Both spindles are actuated by means of links operated by a lever or handle. The cap is held in a small fixture during the drilling operation.

The stylo sleeve is made from 10-karat gold seamless tubing with an outside diameter of 0.070 inch and an inside diameter of 0.032 inch. The countersinking and forming operations are performed on a watchmaker's lathe equipped with an automatic collet feed, a small countersink, and a combination forming and cutting-off tool. The tools are operated by a set of cams attached to the back of the lathe and geared from the headstock. The winding of the coil *C* at the upper end of the stylo is performed in a bench lathe, and the assembling of the pen is accomplished by hand. The stylo is made from 0.037-inch wire of a gold and nickel composition.

When the pen is completely assembled, the stylo and stylo sleeve are lapped. This operation is very important, as it is essential that the stylo slide over the paper very smoothly; otherwise it will dig in and either tear or blur the paper. Originally, the lapping operation was performed by hand, the workman using a motion similar to that often employed in penmanship practice, with the point of the pen resting on a cast-iron plate charged with emery dust and oil. This was a time-consuming operation and, moreover, the lapping was not uniform, in some instances a flat place being lapped on one side of the stylo. The lapping machine not only increased production but also insured a more uniform product.

The cast-iron base *A*, Fig. 2, of the lapping machine has a three-point bearing, each bearing having a bolt hole in it to permit clamping the machine to the bench. From the center of the base a boss projects, which is faced, counterbored, and recessed to receive the rotor shaft *B*. The rotor shaft is made of Shelby seamless tubing, turned to a running fit in the hole in the base, and threaded near the center and also at the lower end to receive the nuts *C* and *D*. These nuts are held in position by set-screws, which bear on small brass shoes *E* and *F*, as shown. The upper end of shaft *B* is turned to a press fit in the hole in spider *G*, and a cone-point set-screw *H* prevents the spider from turning on shaft *B*. A worm-wheel *I* is keyed to the lower end of shaft *B*, and is driven by a worm *J* keyed to the driving shaft *K*. The shaft *K* passes through the bosses on each side of the base *A*. A grooved driving wheel is attached to one end of shaft *K*.

The spider *G*, which is fastened to the upper end of the rotor shaft, consists of six arms which terminate in six bearings for the pen-holder tubes, one of which is shown at *N*. These bearings are accurately bored to insure alignment with the groove in the lapping plate, which is made up of the two rings *O* and *P*. A stationary shaft *Q* extends the entire length of the rotor shaft. To the upper end of this stationary shaft is fastened a friction cone *R*. The lower end of the shaft passes through a bracket which is fastened to the base. This shaft is held in place by a set-screw and thrust nut.

The pen-holder tubes *N* are also made of Shelby seamless tubing, turned to a running fit in the spider bearings and threaded to receive the adjusting nuts *S*. These nuts are prevented from rotating by set-screws which bear on small brass shoes. The upper ends of the tubes have an elongated slot machined in them to receive set-screws *T*, which are threaded into the small friction cones *U*. The lower end of tube *N* is milled back a distance of 4⅞ inches to provide clearance for inserting the pen. A clearance for the fingers is also milled at *V*, as shown in the side view. The spring clip *W* performs the function of approximately locating or aligning the pen with the hole in the adapter *X*. Spring

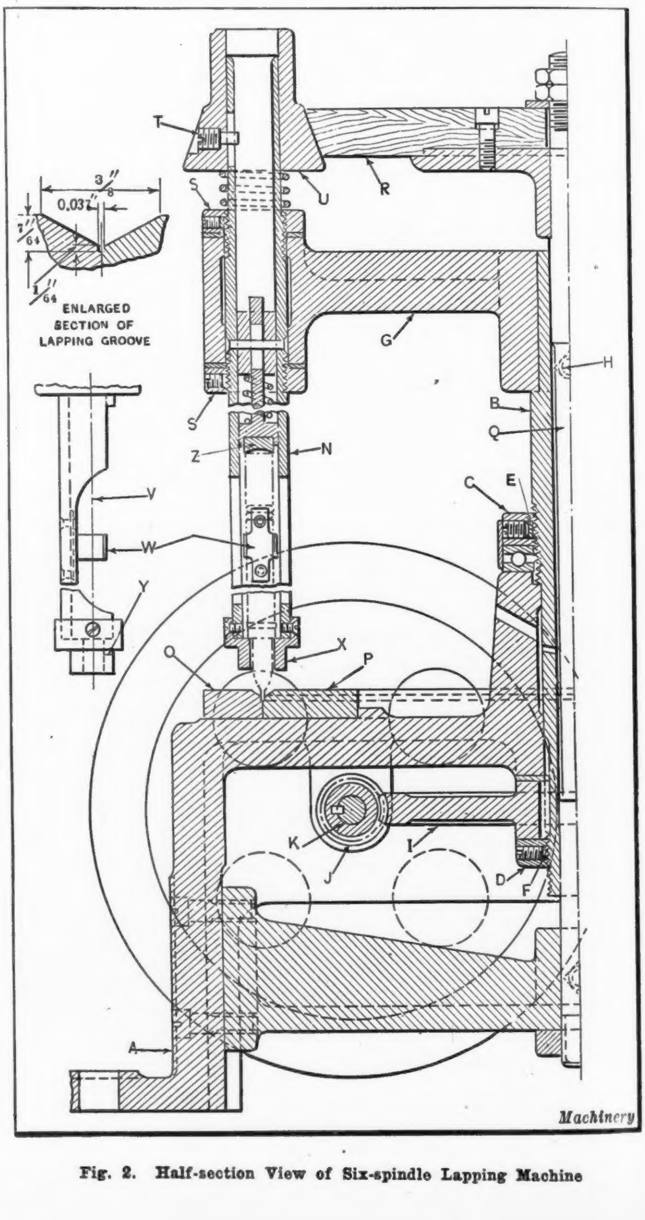


Fig. 2. Half-section View of Six-spindle Lapping Machine

plungers are inserted in the pen-holder tubes, the ends of which are tipped with rubber pads Z to provide a good grip on the work. The spring that actuates the plunger is designed to exert just the right pressure to hold the pen in place.

The adapter X, at the lower end of tube N, is held in place by means of small flat-head screws. As two different diameters of pens were lapped on the machine, it was necessary to make an adapter for each size. These adapters function as gages or locating stops, the shoulder of the pen resting against the bottom of the counterbore. The nose of the pen is allowed to float in the hole of the adapter, thus permitting it to align itself with the groove in the lapping plate. A small slot is cut through the adapter X and tube N at Y, to give sufficient clearance for inserting the pen easily in the holder. The small cone U, attached to the tube N, is held in contact with the stationary wood driving cone R by means of helical springs. These springs are sufficiently flexible to allow the operator to push down the small cone and thus disengage it from the stationary driving cone.

The lapping plate is made up of two rings O and P, to facilitate machining the groove. The inner ring is made a close fit in the outer ring, after which both rings are grooved. The smaller diameter of the inner ring is also made a tight fit around the shoulder on the base A, which serves to locate the assembled lapping plate concentric with shaft B. The machine was belted up to give the spider of the lapping machine a speed of 2.1 revolutions per minute, and the ratio between the diameters of the stationary driving cone and the small cones U was calculated to give the pen-holding tubes a speed of about 5 revolutions per minute. These speeds were selected after experiments had been conducted to determine how many circular movements were required to lap the stylo point to the desired smoothness and form.

The pens are inserted and removed from the machine while it is in operation. As each holder reaches a position in front of the operator, the small cone U is pushed down with one hand and the work inserted with the other. The pens are brought to the operator with the cap assembled. On releasing the cone, it again engages the large stationary cone, thus causing the work-holding tube N to rotate. Although the spider rotates continually, the speed is so slow that the operator can easily remove the pen and insert a new one in one-sixth to one-eighth of a revolution. In inserting a pen in the holder, the cap is placed in contact with the rubber pad Z of the spring-actuated plunger in tube N, and an upward pressure is exerted on the pen in order to bring the point above the bottom of the slot at Y, so that the pen can be pushed into the holder and allowed to drop down into contact with the lapping plate.

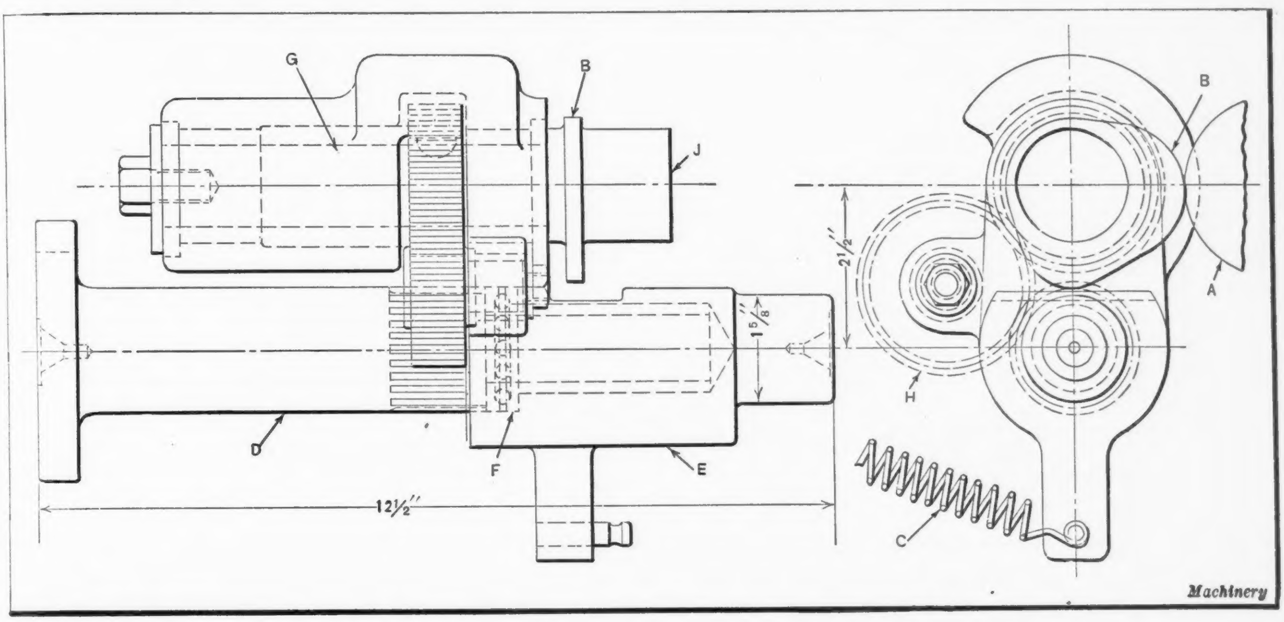
The compound used for lapping is made of a light grade of lard oil and diamond dust, the mixture being of such a consistency that it flows freely. At the end of each day the operator inserts two small brushes in two of the work-holding spindles, and after pouring a small quantity of kerosene into the lapping groove, allows the machine to rotate in order to clean out the groove. The groove is then wiped out with a piece of cloth. About once a week the outer ring is removed from the inner one, and the grooves given a thorough cleaning.

* * *

CAM-GRINDING ATTACHMENT

By J. E. COLLINS

A cam-grinding attachment designed for use on a regular grinding machine is shown in the accompanying illustration. It is mounted on centers, and can be quickly set up or removed from the grinding machine. The attachment is primarily intended for quantity production work, and has a capacity for grinding cams of any shape up to 3 inches in diameter. A special casting (not shown) is also attached to the grinding machine ways to hold the stationary cam-throw wheel A in the required position. The master cam B is held in contact with wheel A by spring C.



Cam-grinding Attachment designed to be mounted between the Centers of a Grinding Machine

The center of shaft D is mounted on the faceplate center of the grinding machine. One end of the shaft is made a running fit in the body casting E, and is provided with a ball thrust bearing F which takes the end thrust of the tail-stock center. The jack-shaft G which carries the master cam B, is driven by shaft D through the idler gear H. The cam to be ground is attached to the face J of jack-shaft G. As the master cam B rotates against the cam-throw wheel A, a rocking motion is imparted to the body casting E which results in the production of a cam that is an exact duplicate of the master cam B. The grinding wheel must, of course, be properly set and the work correctly located on face J of shaft G. Cams of different shapes are produced by replacing shaft G with a similar shaft provided with a master cam of the desired shape.

* * *

The United States Geological Survey estimates that the potential water power of the world totals about 440,000,000 horsepower, of which so far only 23,700,000 or hardly more than 5 per cent has been developed.

Reboring Automobile Cylinders

By GEORGE WILSON

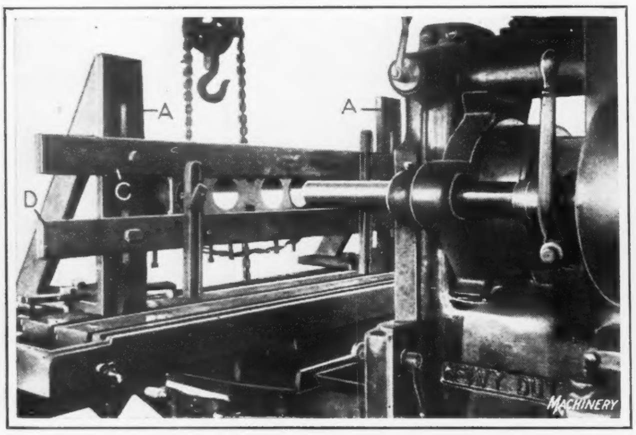


Fig. 1. Milling Machine equipped for reboring Automobile Cylinders

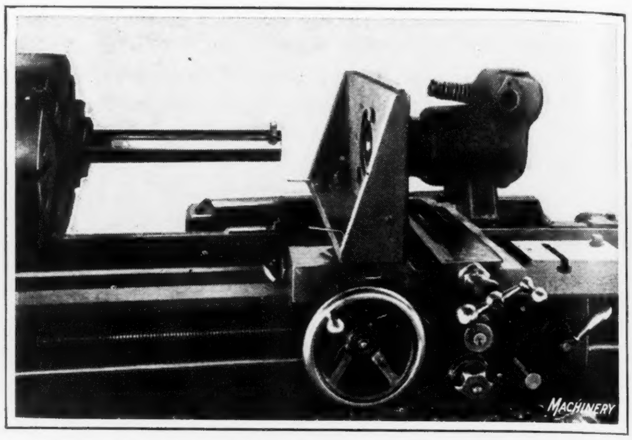


Fig. 2. Lathe Set-up for reboring a Tractor Cylinder

THE small job shop or repair shop is frequently called upon to refinish cylinder bores that have become worn or scored. The cylinder grinding machine provides an ideal means of accomplishing this operation, but the volume of work obtainable by many small shops does not warrant the purchase of a machine of this kind. However, if the small shop is equipped with a milling machine or lathe of suitable dimensions, cylinders can be refinished by providing simple fixtures and tools for these machines. The rate at which cylinders can be refinished by machines equipped in this way compares favorably with that obtained by grinding.

Boring Automobile Cylinders on a Milling Machine

In Fig. 1 is shown a milling machine equipped for boring automobile cylinders of any standard size. This machine has a longitudinal table travel of 34 inches, and a cross feed movement of 12 inches. A six-cylinder casting is shown mounted on the fixture. The fixture consists mainly of a pair of cast-iron brackets *A* which support two bars *C* and *D* to which the cylinder casting is clamped. Brackets *A* are accurately machined on two sides and located on the milling machine table in such a way as to bring the work-supporting bars exactly at right angles with the spindle of the milling machine. Strips are fastened to the brackets which fit into the slots in the milling machine table so that accurate alignment is always assured.

The method of clamping the cylinder castings to the bars *C* and *D* is shown in the illustration. It will be noted that the angle brackets are slotted to permit the work-holding bars to be adjusted to accommodate cylinders of different sizes. Bars *C* and *D* are made from rolled stock, 1 inch by 4 inches in cross-section.

The boring-bar should be made as large as the smallest size of cylinder that is likely to be bored will permit. A boring-bar 2¼ inches in diameter is about the right size for the general run of work. The boring-bar may be fitted in the tapered hole of the milling machine spindle, and held in place by means of a draw-in bolt, but as this usually necessitates reducing the diameter of the bar a better plan is to fit the bar to the spindle nose in the manner employed for face milling cutters. If necessary, a flange can be shrunk on the bar which can be bolted to the spindle nose. If the boring-bar is turned down to fit the tapered hole in the spindle, chattering is likely to result.

A single-point tool may be used in the end of the boring-bar, but a better plan is to make up a cutter-head which will hold several cutters. This type of tool will produce a much better surface and will stand up longer under severe usage. When a cutter-head is used, the cutters are set in place and ground for each size of bore, a special grinding arbor being used for this purpose. One cutter-head can be used for boring several sizes of cylinders by adjusting the tools in or out as required. After adjusting the cutters in the head, they should always be ground before the tool is placed in operation. Of course it is always desirable to use a cutter-head that is nearly the same size as the cylinder bore, so that the cutters will be supported close to their cutting edges.

A cutter-head can be set and ground in about 1½ hours. With a single-point tool, considerable time is required in gaging the cylinder bores. With the cutter-head type of tool, no gaging of the cylinder is necessary, as the size of the bore is determined within very close limits by the cutter grinding operation. About 1/32 inch is the minimum amount that should be removed when reboring a cylinder in order to assure cleaning up the cylinder walls. If a finer cut is taken, it will be difficult to keep the point of the tool under the glazed surface. Unless the cylinder is scored deeply, the depth of cut need never be much over 1/32 inch deep, but this is controlled to a certain extent by the accuracy with which the cutter is centered in the bore.

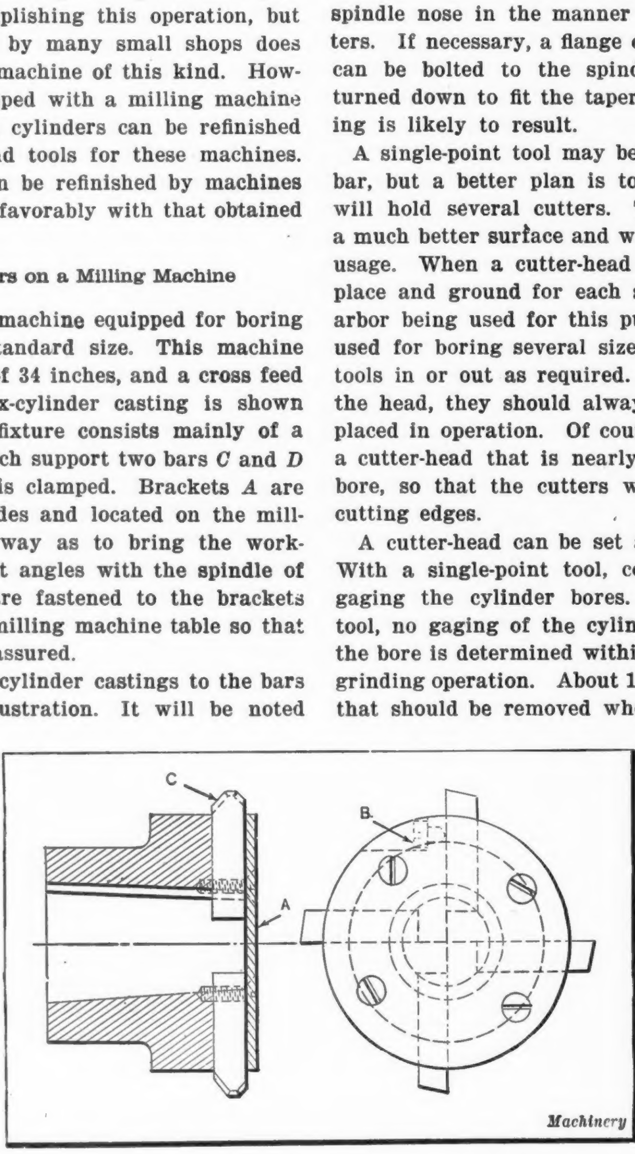


Fig. 3. Tool-head designed for Use in reboring Cylinders

The end cylinders are leveled up with the table, so that only a horizontal adjustment is necessary when changing from one bore to another. This

can be done very quickly by determining the center-to-center distance between the cylinders, and employing the dial on the longitudinal feed-screw to measure or gage the required movement from one bore to another.

One cut through each cylinder bore, using a rather fine feed, is usually sufficient to obtain a surface of the required smoothness. Deep scores can be filled with silver solder or one of the special solders made for this purpose, before performing the boring operation. The cutter-head can be of either cast-iron or steel, and should have a tapered hole carefully fitted to the tapered end of the boring-bar. A key should be employed to prevent the cutter-head from slipping on the bar.

As many cylinders are designed with blind ends, or in other words, with the heads cast on the cylinder walls, it is necessary that the design of the boring tools be such that the cutting edges will be as close to the end of the head as possible in order to permit them to pass completely through the bore into the narrow combustion space at the cylinder head. This requirement can be fulfilled by milling slots across the end of the head to receive the cutters, as shown in Fig. 3.

The cutters are ordinarily made of square high-speed tool-steel bits that are ground smooth on all four sides so that they will be a fairly close fit in the slots. The cutting edges of the tools can be located in planes that pass through the center of the head. A thin plate *A* fastened to the tool-head with flat-head screws in addition to set-screws *B*, serves to hold the cutters in place.

The best results will be obtained by grinding the cutters so that only a small portion of their ends will be in contact with the cylinder. A cutter of about the right shape is shown at *C*. By using a comparatively sharp-pointed tool, chattering will be reduced to a minimum, and the tools will not be likely to jump or dig in when passing over openings in the cylinder wall. A wide-faced tool is likely to leave a high spot opposite any opening in the cylinder wall, due to the springing of the tool-bar as the opposite cutter passes the opening.

This trouble might be overcome in a measure by using a cutter-head with an odd number of cutters, but if this is done, it is necessary to provide a removable pin that is inserted opposite one of the cutters during the grinding operation, so that the diameter of the hole that will be produced by the cutter can be easily determined by taking a measurement over the end of the pin and the point of the cutter opposite.

When a properly constructed cutter-head provided with accurately ground cutters is used, the variation between the diameter of the first and last bores finished on a six-cylinder block will not be more than 0.001 inch. Perhaps the best results are obtained by using a portable electric grinder to sharpen the cutters in the boring head without removing the latter from the milling machine spindle.

Boring Automobile Cylinders in a Lathe

In Fig. 2 is shown an 18-inch lathe equipped for boring automobile cylinders. An accurately machined cast-iron angle bracket, long enough to accommodate the average cylinder block, is bolted to the carriage of the lathe. To facilitate setting up the fixture and also to assure squareness with the lathe spindle, the bracket may be doweled to the carriage.

The hole through the vertical face of the angle bracket or plate is bored true with the spindle, to permit the cutter- or boring-bar to pass through. A cutter-head similar to that used on the milling machine shown in Fig. 1 can be used on the spindle, if desired. The bar may be threaded to fit the spindle, or it can be flanged and bolted to the faceplate. Dowel-pins can be used in the flange and the faceplate to assure accurate alignment of the bar when it is replaced after it has been removed for grinding or to permit the lathe to be used for other work.

For large cylinders having an open head, a boring-bar held between the lathe centers may be used. When this is done, a single-point cutter mounted midway between the ends of the bar is used. However, this method requires the use of a very heavy boring-bar to prevent chattering. For boring cylinders 6 inches in diameter, for instance, a bar about 4 inches in diameter and not longer than is absolutely necessary should be used.

* * *

ANALYZE STEEL BEFORE CONDEMNING HEAT-TREATMENT

By ARTHUR L. COLLINS

The failure of heat-treated parts to stand up is often attributed to some fault in the heat-treating process, when the trouble is actually to be found in the quality or nature of the steel used. Mistakes of this kind are seldom made, however, in plants provided with testing laboratories where all raw materials are carefully analyzed.

In a plant employed in the manufacture of knitting machines, large quantities of 0.40 to 0.60 per cent carbon steel tubing was used in making the knitting cylinders. Grooves were cut in these cylinders to receive the needles, and the walls separating the grooves were only about 1/16 inch thick. The cylinders were required to be hard enough to prevent these walls from being bent over, and at the same time tough enough to eliminate the danger of cracking or breaking. The operation of cutting the grooves required about two days, and consequently the finished article represented a considerable labor cost. The cylinders were heat-treated just before the final operation of polishing.

After a lot of these cylinders had failed in service by having the thin walls bend over, blame was placed on the heat-treating process. The whole plant was tied up and production curtailed until the heat-treatment was carefully investigated. Finally a chemical analysis was made of the steel in one of the cylinders that had failed. It was discovered that the material instead of being 0.40 to 0.60 per cent carbon steel contained only 0.10 to 0.20 per cent carbon, which on heat-treatment would not show any appreciable hardness. It would have been an inexpensive proposition to have taken an analysis of each piece of tubing as it came in. But this plant had no works laboratory, yet they lost enough in labor and material on this one item to support a laboratory for six months.

In the same plant, it was customary to buy all kinds of steel for tools—alloy, straight carbon, and high-speed steel. When received, these steels were put into a bin without further marking, and as needed, a piece was drawn out of the bin, ground, or machined to shape, and sent to the hardening room to be hardened. The hardener would take a look at it, and harden it for a straight carbon or high-speed steel or an alloy steel, depending on what he thought it was. As a result, about half the tools were ruined. It would have been an easy matter to distinguish between a straight carbon and a high-speed steel by means of the "spark test."

When doubt exists as to whether a tool is straight carbon or high-speed steel, the tool should be put on the grinding wheel and the character of the spark noted. The presence of tungsten in the high-speed steel causes a dark spark, while the straight carbon or tungstenless steel will give a voluminous bright spark. An apparatus has been built for this particular kind of testing, and it is claimed that with it an experienced operator can tell the carbon content of a sample within five points (0.05 per cent).

* * *

At the end of 1922 there were 12,357,375 automobiles and motor trucks registered in the United States, a gain of 17.6 per cent over the figures in 1921. This indicates that there is an automobile or motor truck for every ninth person in the country.

Gage Inspection Methods

Use of High-grade Measuring Equipment for the Inspection of Small Tools

By FRED R. DANIELS

THE object of this article is to present, by an examination of the inspection methods employed in a plant where precision tools are made, a comprehensive idea of the methods used in modern gage inspection.

The influence of changing temperature, causing expansion and contraction of the metal, is one of the chief difficulties encountered in high-grade small tool inspection. Both the work and the instruments used are affected, each in proportion to its mass. Gage-blocks, which represent the highest degree of perfection in commercial accuracy, are only guaranteed at a given temperature. Hence, it will be seen that temperature is a very important element in the inspection of high-grade gages and small tools.

The small tool inspection department of the Taft-Peirce Mfg. Co., Woonsocket, R. I., is designed with a view to eliminating, as far as possible, errors due to changes in temperature. This department is in proximity to the grinding and lapping departments, but separated from them by another room, and is accessible only to those concerned with the inspection of gages and tools. The room itself is provided with a double ceiling and a secondary partition, located about three feet from the outer wall of the building. In severely cold weather an electric heater is used to maintain as uniform a temperature as possible; it is never allowed to vary more than 5 degrees from an average of 68 degrees F. A Bristol temperature recorder registers the changes throughout the day, and furnishes a record which is available as a means of determining the temperature at any given time when a certain tool was inspected. This reference chart makes duplication of measurement possible. Knowledge of the temperature at the time a gage is measured is also a decided help in checking up errors reported by customers, particularly if it is known that the gage has actually been used in a very different temperature from that at which it was inspected. If a large instrument, such as a measuring machine, is used, the work is often laid on the machine for awhile before taking a measurement, until it acquires the same temperature as the machine.

Wear of Inspection Standards a Troublesome Factor

Wear is another troublesome factor in the attainment of precision measurements. No matter how accurate the

Fig. 1. Measuring Machine for inspecting Small-diameter Work

Fig. 2. Inspecting Screw Thread Diameters by Three-wire Method

gage-block, thread measuring wire, parallel, or other unit may be when it is new, the condition of the instruments must be very carefully watched and periodically checked. The amount of wear must be ascertained if dependable results are to be had. In the inspection room mentioned a practice is followed of checking the gage-blocks at stated intervals with a master set of blocks, which is calibrated from time to time by the Bureau of Standards at Washington. The amount under size that each block may be found to be, as compared with the master block, is tabulated for reference, so that when subsequently used, allowance for this wear is made. Likewise it is vital that the exact size of used screw thread measuring wires be determined, for these wear considerably, and all three wires of a set must be of the same size throughout; otherwise, the results will be inaccurate.

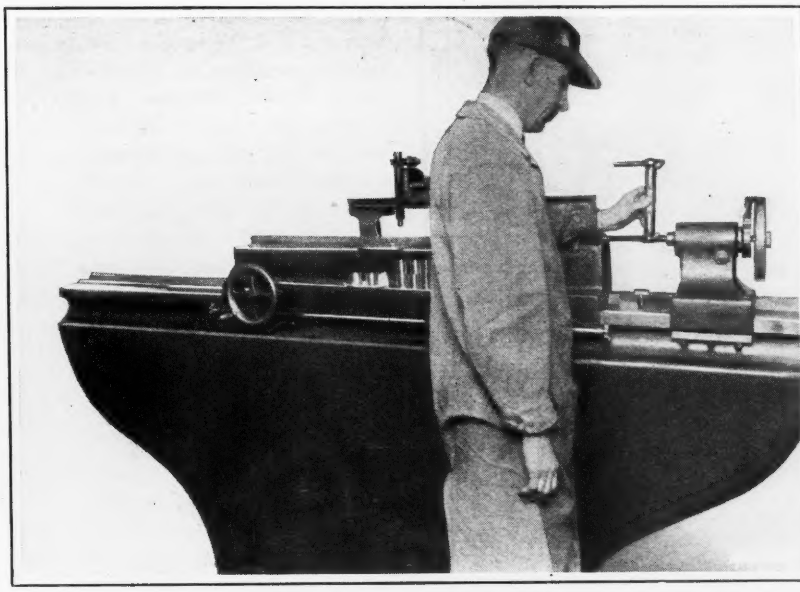


Fig. 3. Use of Measuring Machine for inspecting Pin Limit Gage

The diameters of thread measuring wires are inspected in a Newall machine of the type shown in Fig. 1. If wear is discernible by the use of this machine, a note is made of the amount on the size tab in the measuring wire case, so that no excuse can be offered for errors made in inspecting screw threads with wires of uncertain diameter.

Some Uses of Measuring Machines

There are two designs of measuring machines used in the Taft-Peirce small tool inspection department. The Newall machine, shown in use in Fig. 1, is generally employed on the smaller class of work of less than one inch in size. Its main feature is the spirit level, which, by a very slight movement of the left-hand anvil, will tilt and cause the bubble to reveal, greatly magnified, even a slight movement.

The graduations on the level are coarse, and three divisions are equivalent to a movement of the anvil of 0.0001 inch, so that fractions of this unit of measurement are easily detected. For this reason, a machine operating on this principle will easily show not only errors in diameter and length, but also inaccuracies in roundness. These errors would be difficult to detect in a machine where the hands are used directly in setting the gaging anvils. The vernier wheel at the right is graduated to 0.0001 inch, and by the use of the vernier scale, direct readings to 0.00001 inch are possible. There is also a scale at the top of this wheel which permits a one-inch longitudinal movement of the vernier head, although such a movement is rarely required.

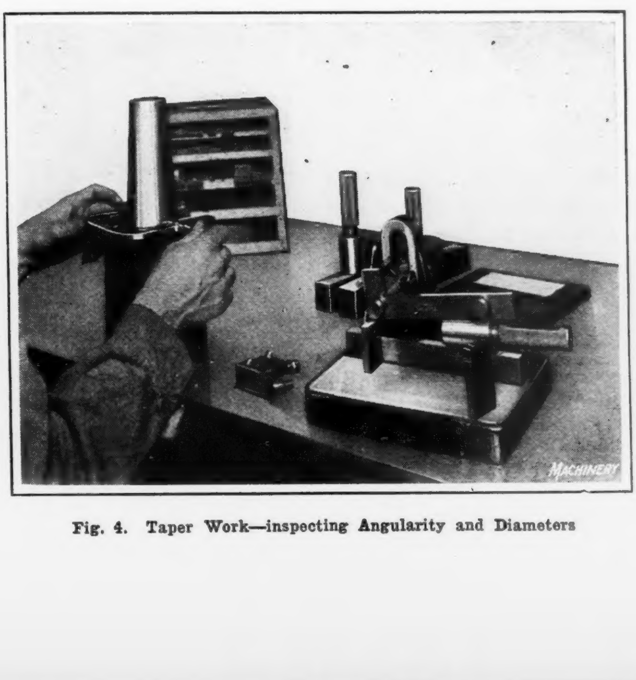


Fig. 4. Taper Work—inspecting Angularity and Diameters

The Taft-Peirce measuring machine, shown in Fig. 3, is of an entirely different design from that just mentioned, both as regards appearance and method of use. It will be seen that this is not a bench machine, but rests on the floor, and has a massive bed on which a 400-pound slide is accurately fitted. The rear bearing is a V-way, and the front a flat surface. With this bearing, the heavy slide can be moved very easily by turning the hand wheel shown at the front of the machine, because there is always a film of oil between the bearing surfaces.

In adjusting the machine for taking a measurement, the slide is first moved to an approximate setting, and the final adjustments are obtained by the vernier head shown at the end of the machine, which adjusts the movable anvil. There is a length standard in the form of a rectangular bar on the top of the slide, in which gold pins are set at intervals of one inch, and at one end at intervals of 1/4 inch, accurately tested for spacing by the Bureau of Standards at Washington. Each gold pin is scribed with a fine hair line. This is used in connection with a Bausch & Lomb microscope, on the lens of which there is a hair line which is brought to coincide with a given hair line, on the length standard, when setting the slide amounts of 1 or 1/4 inch. The slide may also be set by using precision gage-blocks.

In setting the machine, with the aid of the microscope and standard, to check the measuring lengths of the pin gage shown in Fig. 3, this procedure would be followed: The limits on this gage are 5.249 and 5.2515 inches. The slide would be set first to 5 1/4 inches by bringing the hair lines into coincidence. Then the setting for the low limit would be obtained by advancing the movable anvil 0.001 inch, reading from the graduated micrometer head on the end of the movable anvil. A movement in the opposite direction of this movable anvil is then made, without changing the setting of the slide, to obtain the high limit. The slide is clamped when the hair lines coincide, and remains in this position as long as the adjustments can be taken care of by the anvil, which has a movement of 1/4 inch.

Another method of setting this machine, and one that is frequently employed, is that of using precision gage-blocks to set the slide to the nearest thousandth reading, and then getting the finer adjustments by the micrometer head. In the case of the pin gage shown in Fig. 3, this method of setting was employed, gage-blocks being used to obtain a distance of 5.249 inches between the anvils. In like manner, the maximum reading is obtained.

If the gage-blocks used have been calibrated and shown to be slightly under size, the accumulated error, which will

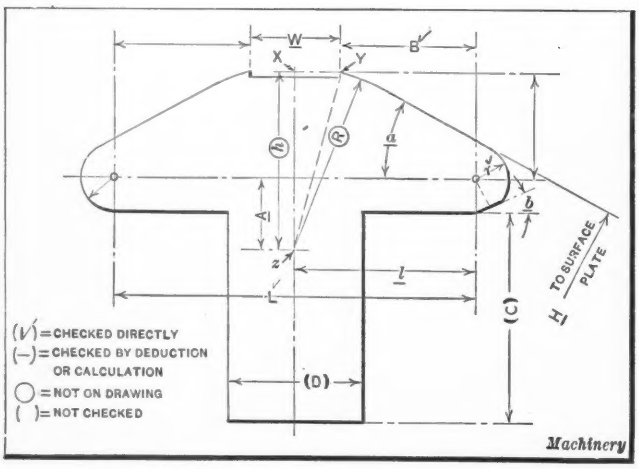


Fig. 5. Profile Gage checked with Sine Bar Fixture

probably not be more than 0.0001 inch, must of course, also be taken into account in setting the movable anvil. There is a vernier scale used in connection with the graduated micrometer wheel for obtaining readings to ten-thousandths inch. On the slide of the machine may be seen a number of plug gages placed there to acquire the temperature of the slide. The high degree of accuracy obtainable with this machine is made possible by the rigidity of its construction. It is regularly used for all work larger than one inch in size, generally in connection with precision gage-blocks.

This machine is also used for measuring the pitch diameter of thread gages by the three-wire method, as shown in Fig. 2. The rigidity of the machine makes it valuable for this purpose. The gage shown is 1 inch in diameter and has eight U. S. standard threads per inch. For inspection work of this kind, a chart is used, giving the measuring wire sizes that can be used for different pitches, and the "best" wire size for a particular pitch. The formula for the particular form of thread being inspected is then applied, and the result should correspond with the reading obtained on the machine. These formulas may be found on pages 1031 and 1032 of MACHINERY'S HANDBOOK.

Use of Lead Measuring Machines

The use of a Taft-Peirce lead testing machine is shown in the heading illustration. The slide of this machine has a three-point ball bearing on the bed, one ball being at each end of the slide, and the third under a supporting arm which extends at the rear. The work is located between adjustable centers, and the setting of the slide is accomplished by revolving the micrometer head at the end, and checking the setting by means of a hair line on the extreme end of stylus arm *A*, which is made to coincide with a hair line on the microscope lens. The outer end of the stylus arm is flattened and gold-plated, and the hair line is scribed on this surface.

The opposite end of the stylus arm has a ball point which, when correctly set, bears equally on each flank of the thread. When this setting is obtained, the opposite end of the arm is central in a guide. The arm is supported directly back of the gage by a flat vertical spring, parallel with the axis of the thread gage, which permits a pivotal movement for the stylus arm in a horizontal plane only. If the slide is operated to change the position of the gage, the ball point on the stylus arm will slide up on one flank of the thread and locate in the next thread space. If the movement of the slide to bring about this result agrees with the correct lead measurement, then the hair line should again coincide and the stylus arm be central in the guide at its outer end.

Usually, in measuring lead, it is customary to locate the stylus in a given thread first, and then calculate the distance to some other thread, skipping, perhaps, four or five threads. In this way any accumulated error can be readily detected and the average per thread found. The gage shown being inspected, is 1¼ inches in diameter, and has six Acme threads per inch.

Although plaster casts of a section of the thread in a ring thread gage are sometimes made and inspected by the use of a thread comparator for thread profile, it has been found by the Taft-Peirce Mfg. Co., that adequate inspection of ring thread gages is usually obtained by inspecting the finishing lap and fitting it to the plug thread gage after it has passed inspection.

The Inspection of Taper Plug Gages

For the inspection of tapers and for all angular measurements on small tools and gages, the Taft-Peirce sine bar fixture shown on the surface plate in Fig. 4 has general application. The sine bar is in the form of a try-square with one leg much shorter than the other. For work of average size, such as the taper plug gage shown in position, the long arm is used, and the sine of the angle employed in making the calculations; but on small work, particularly where the taper is slight, there is considerable opportunity for inaccuracy in using the long arm, because the gage must be held so far from the apex of the included angle. For work of this kind, the short arm is used, and the cosine of the angle (or the sine of the complement of the angle) employed in making the calculations, or else the sine bar is set while the fixture rests on its end, as shown in Fig. 7.

A parallel forms the under locating surface, and the gage is measured between the parallel and the sine bar. On high-grade inspection, the setting of the sine bar requires the use of gage-blocks. An adjustment is provided so that the correct setting can be obtained after first locating to the approximate angle by sighting between the gage and the sine bar. Then gage-blocks are used under the buttons to check the angle. On the surface plate directly in back of the sine bar fixture in Fig. 4 there will be noticed a set of thin gage-blocks. These are accessories to the regular gage-block sets, and are especially useful when fine settings are required, as is nearly always the case when angles are involved. On certain classes of work the height gage may be used satisfactorily to check the setting of the bar.

After the included angle has been inspected, the diameters at the large and small ends should be measured. To do this conveniently, the gage is sometimes stood on its small end and stacks of gage-blocks used on opposite sides, on which accurately ground measuring pins (usually of ¼ inch diameter) are supported. Measurements are then taken with the micrometer at two or more heights, and

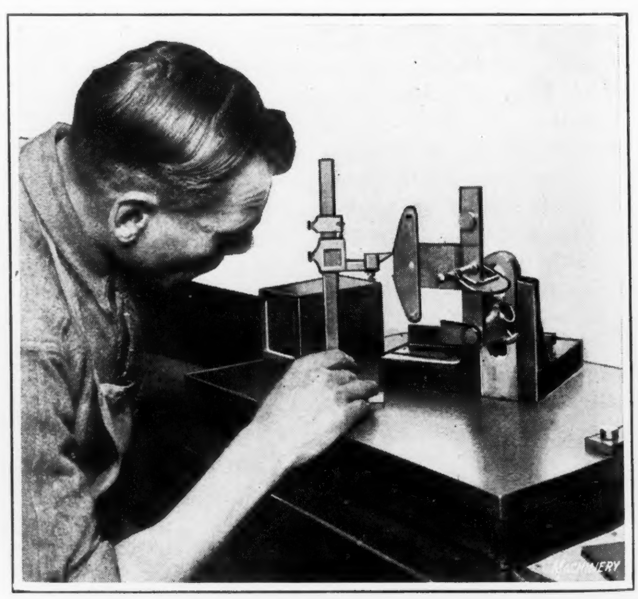


Fig. 6. Using Height Gage to check Dimension, with Fixture resting on its Base

the readings used to check the taper per inch or included angle of the gage.

Another convenient way of taking these measurements is to use a hollow block or parallel, as in Fig. 4, and insert the handle of the gage with the large end resting on the end of the block as shown. The measuring pins are then used, as before, and a measurement taken over them as shown. This set-up permits the micrometers to be used with greater convenience, perhaps, than when gage-blocks are employed to support the pins, and probably this method gives practically as accurate results. In measuring the small end of a taper plug, the same method is used with the gage resting on the surface plate itself. It is good practice to calculate the diameter of the small end after the measurement at the large end has been obtained, and then check this diameter with the actual measurement.

Application of the Sine Bar Fixture

Profiles and angles can best be inspected by the use of the sine bar fixture. For this class of work, however, the requirements for accuracy are usually less severe than for a limit thread, plug, or snap gage. For that reason, a vernier height gage is often suitable for setting the sine bar and for taking measurements on work of this kind.

The use of the sine bar fixture for inspecting the dimensions and angles of a profile gage is illustrated in Figs. 6 and 7. The gage is shown in Fig. 5, partially dimensioned. Those dimensions that are to be checked directly are indicated by a check mark; those checked by calculation, by underscoring; those enclosed in circles are dimensions not found on the drawing of the gage; and those designated by arrowheads only, indicate measurements taken to verify or recheck those already inspected. The other dimensions C and D are not checked.

The sine bar is reversed from the position shown in Fig. 4, so the surface plate can be used as a measuring surface, instead of the limited area of the sine bar fixture base. The gage is clamped to the long arm, and the height gage used under the buttons to locate the bar horizontally, the fixture resting on its side. After the bar has been clamped securely in the horizontal position, the fixture is turned on its base and the height gage used along the lower straight edge of the gage, to set it at right angles to the sine bar. The clamp is then tightened. While in this position, all dimensions that can be reached are checked.

These are two construction holes in the ends of the gage in which 1/8-inch measuring pins are used. The first reading is taken from the under side of the lower pin, and the next from the extreme lower end of the gage. This checks radius r, Fig. 5, and a measurement is then taken between the two pins to check L. The measurement shown in Fig. 6 is next taken. This is from the under side of the notch to the under side of the upper pin, and when a corresponding measurement is taken in inspecting the other half of the gage, the width of the notch can be checked and dimension L verified. This measurement and the one at the opposite end should, of course, agree.

Fig. 7. Checking Another Dimension after Fixture has been turned on its End

Fig. 8. Checking the Spacing of Slots in a Ten-slot Spline Gage

The fixture is next turned on its side, and the sine bar reset to an angle that will bring the measuring point of the height gage into a line tangent with the rounded end of the gage. Gage-blocks or the height gage are then used to take measurement H (see Fig. 5) from which the sine of angle a can readily be calculated. The height gage is then moved over to the position shown in Fig. 7 with the measuring point at the corner of the notch, tangent to radius R, Fig. 5. This requires changing the angularity of the bar so that the triangle XYz can be solved, and then the distance h and radius R, which are not given on the drawing, can be checked.

To verify or recheck distance h, the sine bar is set horizontally, and the perpendicular distance taken from point Y to a 1/8-inch test pin. This reading added to dimension A is a check for h and the radius R. Finally, the bar is reset for checking angle b, and the perpendicular distance from this angular side to the test pin is obtained, from which measurement and the radius r, the angle b can be calculated.

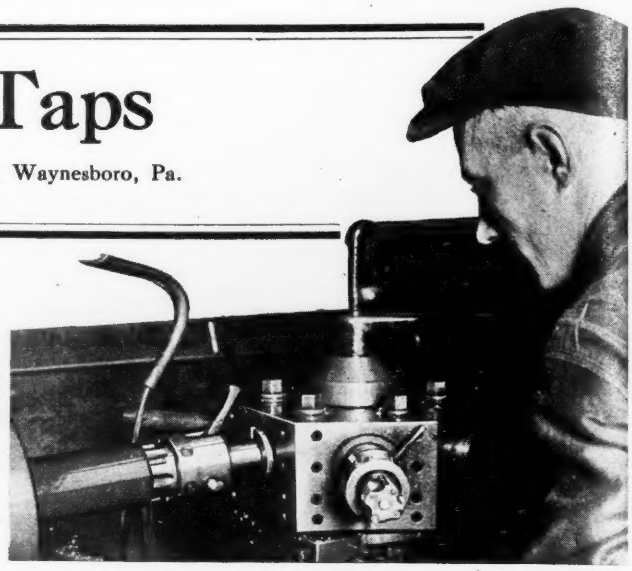
Bench Centers with Dividing Head

For the inspection of gages requiring angular settings from a center, such as the spline gage shown in Fig. 8, the Taft-Peirce bench center with a dividing head is used to advantage. The work is clamped to the faceplate of this head and located centrally. For convenience in clamping work to the faceplate, the latter is tapped for 3/8-inch bolts at various radial distances. If the gage is of comparatively small diameter, a parallel is used from which to take the measurements, which in this case are checked by Johansson gage-blocks, using an auxiliary scriber, wrung on the uppermost block, to serve as a precision height gage.

The scriber is passed along the side of a slot, and the dividing head is then set the required angular amount between slots, which in this case would be 36 degrees, for a ten-slot spline gage. On the opposite end of the bench center head from that shown in Fig. 8 there is a sine bar attachment mounted on a faceplate which is used in connection with graduations on the periphery, in obtaining the angular setting. By the use of the sine bar, the head is set to the new position, 36 degrees advanced, and a second measurement is taken with the gage-block height gage, and so on until each slot has been checked for spacing on one side.

Collapsible Taps

By ROY G. MUMMA, Victor Tool Co., Inc., Waynesboro, Pa.



WHILE collapsible taps have been used for, perhaps, twenty years or more, it is only within comparatively recent years that they have come into general use and been considered standard tools. Taps of this type have not only found a place in turret lathe tooling equipment, but are also being applied, on an increasing scale, to various other kinds of machines. The forerunner of the collapsible tap was undoubtedly the self-opening die-head for external threading, which has been on the market for probably fifty years. The many advantages of this tool over the ordinary solid dies which had to be backed off the work after the thread was cut were so apparent that men began to experiment in applying the same idea to internal threading, or a tap with cutters that could be collapsed, just as self-opening die-head cutters or chasers were expanded to free them from the threads.

The first serious handicap encountered was the question of size, since it was necessary to keep the body of the tool small enough to enter the hole being tapped. This naturally placed severe limits on the size and construction of the mechanism necessary to actuate the chasers, and is still a serious handicap to the extent that even up to the present time no collapsible tap smaller than one inch in diameter has been produced that will stand up when subjected to hard service, and even then its use is restricted to cutting fine pitches in soft metals. It was important that experiments should be made on the smaller sizes of taps due to the fact that the bulk of tapping is done with the smaller sizes, and consequently the best market is for the small taps. The cost of building large taps for experimental purposes was also prohibitive. For this reason efforts were largely concentrated on taps for cutting standard pipe threads. Sizes from one inch up were large enough to warrant experimenting, and there was a sufficient potential market to develop.

Until shortly after the outbreak of the world war, or about 1915, collapsible taps were almost entirely in the development stage. They were little known and certainly far from being in general use. The manufacture of modern ordnance and shells in great quantities, first for European countries and later for the United States, opened up a market and new field for the collapsible tap. The few concerns that were then making them at once endeavored to adapt them to this new class of work, and did so very successfully. They were first used extensively for tapping the nose and base of shells, as well as for a hundred and one varieties of other war work. Many of the large shell plants used hundreds of collapsible taps continuously, and it can be said that this tool contributed a great deal to the manufacture of shells on a real production basis. The expansion of the automotive business at about the same time also opened up a large field for this style of tap.

Advantages of Collapsible Taps

What advantages do collapsible taps have to justify them being called production tools? Their biggest asset undoubtedly is in the fact that they need not be backed out of the hole at the completion of the thread, thereby reducing the actual tapping time and naturally increasing the production. While it does not take quite as long to back a tap out as it does to run it into a hole, due to the faster travel of the machine when reversed, yet, when compared with the instantaneous withdrawal of a collapsible tap all the time so consumed can be considered as lost. Saving in time and increase of production ranging from 10 to 100 per cent have frequently been shown.

Another big advantage over ordinary solid taps is found in the fact that when the chasers become dull they can be ground or sharpened, and then, by means of the size adjustment, can be set to maintain exactly the desired size. This is not usually possible with the solid tap, especially if accurate size is required, as a solid tap, once ground, loses its size. Furthermore, the chasers permit of several grindings, which increases their life considerably beyond that of the solid tap. It is generally conceded that a tap becomes dull and worn while being backed out rather than in the actual tapping, and as there is no backing out with a collapsible tap this condition is naturally eliminated. When the chasers are finally worn out, they can be renewed at practically no greater expenditure than the cost of a solid tap without the necessity of buying an entire new tool, the principle being the same as in a safety razor. Records ranging as high as 80,000 threads in steel with a single set of chasers are known to have been made. Chasers must be renewed, however, in complete sets, and not singly in case of breakage.

When a solid tap is backed out of a tapped hole, it frequently happens that the threads are torn, often spoiling the entire job. Due possibly to the faulty action of the reversing mechanism of the machine, the tap is not properly started, and forcing sometimes causes the threads to be stripped. This is not possible with a collapsible tap, as the chasers are provided with sufficient drop to fully clear the threads. At the same time, well formed threads will insure a better fit of the parts and improve the quality of the work. This condition is especially true in brass work, where good threads are usually required, and where, due to the nature of the metal, the threads are easily torn.

Collapsible taps are usually provided with means for adjusting the chasers for size, making it possible to cut as tight or loose a thread fit as desired. If, by chance, the male threads are cut slightly off standard, it is possible to set the collapsible tap to the required size and obtain a correct fit. Usually this adjustment is about 1/32 inch, either over or under size, there being a total range of 1/16 inch on one set of chasers. This feature also permits setting the chasers to compensate for grinding. Because of the accuracy of size obtainable with collapsible taps, they are frequently used for sizing after the thread has previously been cut with solid tap or chased. A collapsible hand sizing tap especially designed for this work is made by one of the leading collapsible tap manufacturers.

It is not necessary to use a separate tap for each diameter, as with a solid tap, since each collapsible tap body will accommodate several sizes of chasers. This range is not as great, however, as in a die-head for external threading, due to the fact that the nose or front part of the tap must be kept small enough to enter the smallest hole to be tapped. The maximum diameter is controlled by the point to which the chasers may be permitted to extend above the body with-

out support and still be strong enough to bear the strain when cutting. This point is largely determined by the nature of the material and the pitch of the thread being cut. The capacity of the tap varies according to size—the larger the tap, the greater the capacity. For example, in a 1-inch tap, a range of approximately 1/8 inch is all that is practical, while in a 6-inch tap it may be 1 inch or even more. Usually the range also extends from a short distance below the specified size to a trifle above. For example a 3-inch tap would probably have a range of 2 3/4 to 3 1/4 inches. Ordinarily, collapsible taps for standard pipe threads are confined to one nominal pipe size, as the range between sizes is too great.

Limitations in Regard to Pitch of Thread

Next to size the most serious limit in the use of collapsible taps is in the pitches that can be cut. If it were possible to cut standard-pitch threads, as specified for any particular diameter in the various established specifications for different forms of threads, the field for collapsible taps would be greatly enlarged. This limit, therefore, becomes quite serious, as it means that only fine pitches can be cut. This is due to the fact that the chasers cannot be dropped far enough into the body to clear the threads and permit withdrawing the tap. As the tap body must be kept small enough to enter the hole, it is necessary to drop or withdraw each chaser a distance somewhat greater than the depth of the thread, which would be impractical on coarse pitches. Furthermore, the body being so small, would not have sufficient strength to bear the strain, and would possibly twist or even break. For example, the pitch of a 2-inch thread, U. S. standard, is 4 1/2 threads per inch and the thread depth is 0.1443 inch, but it is not practical to tap a coarser pitch than ten threads per inch with this size tap, the thread depth in the latter case being 0.065 inch. This is a point frequently overlooked by shop men considering the use of a collapsible tap, and when their inquiry is turned down by the manufacturer they are disappointed and their general prejudice against collapsible taps is increased.

For practical purposes and as a general rule, it might be stated that the coarsest pitches within the range of these taps run probably from eighteen threads per inch with a 1-inch tap to six threads per inch with a 6-inch tap, other sizes being in proportion. The literature of the different tap manufacturers is usually very clear on this point. This does not apply, however, to standard S. A. E. threads, as these pitches are practical in sizes above 1 1/8 inches. Neither does this condition apply to taps for cutting standard pipe threads, either Briggs or Whitworth, as these pitches are sufficiently fine to come within the range of collapsible taps. There is no limit either, to the forms of thread that can be cut, as U. S. form, Whitworth, V, Acme, and many special forms are practical as long as the pitch is not too coarse.

Some General Classes of Work for which Collapsible Taps are Adapted

The fact that collapsible taps are confined largely to cutting fine pitches makes them especially adaptable for automotive work. Since the close of the war and the discontinuance of shell work, the manufacturers of automobiles and also parts and accessories have undoubtedly been the largest users of collapsible taps. The constant introduction of so-called "novelties" in this field, such as wire wheels, hub caps, radiator caps of many styles and varieties, etc., constantly increases the amount of work on which these taps can be used to advantage. Other common parts on which they are frequently used are gasoline tank filler caps, cylinder blocks, axle and axle housing parts, carburetor parts, steering gear parts, and dozens of others. Another class of work that lends itself readily to the use of collapsible taps is the manufacture of pipe fittings such as tees, ells, Y's, crosses, unions, flanges, etc. The use of these parts in such immense quantities and the keen competition in this work makes their production at low cost necessary, and as practically the only work necessary on many of them is boring and tapping it is easily seen that collapsible taps can be used to great advantage. Special tapping machines are on the market for doing this work, and many of them are fitted with collapsible taps in order to save the time required for backing out solid taps.

Most collapsible tap manufacturers make combination taps with a reamer attached to the front, or reamer blades set between the chasers, making it possible to finish the job complete with one tool. Where there is sufficient room ahead of the thread to pass the reamer, there is an advantage in using a rose reamer ahead of the chasers, as this permits boring and tapping with one pass of the tool. This style is also desirable in small sizes, from 3 inches down, as it does not rob the body of the tap of the necessary strength to withstand the strain. When there is insufficient room to pass the reamer ahead of the thread, and also in sizes 3 inches and larger, it is possible to set the reamer blades between the chasers. This requires two passes of the tool, one with the chasers collapsed while reaming and a second one with the chasers set in position for tapping. Collapsible taps are used extensively in valve bodies made of cast iron, steel, or brass. The screwed ends of these bodies are usually tapped with standard tapered or straight pipe threads. Combination tools are frequently used on this work. To enumerate all the work for which collapsible taps are used or for which they are adaptable would be a difficult task, and the object of this article is to show in a broad way the general classes of work only.

Different Styles of Collapsible Taps and their Application

Generally speaking, collapsible taps are made in two chief styles—stationary and rotary. Stationary taps are used on such machines as turret lathes, hand screw machines, certain automatic machines, boring mills, and any machine where the tap is held stationary and the work revolves. Rotary taps are used on drill presses, radial drilling machines, tapping machines, certain automatic machines, or any machine on which the work being tapped is held stationary and the tap revolves.

In the stationary style, a lever is employed for expanding the chasers into the cutting position by hand. Frequently this is automatically accomplished by bolting a bar of steel to the turret slide guide, which engages the handle on the backward travel of the turret. The rotary tap can be expanded by arranging a yoke or suitable fixture to the spindle housing to press against a collar or flange provided for the purpose, as the spindle is backed away or withdrawn from the work. This permits setting the chasers while the tap is in motion. The ordinary method of collapsing the chasers is by means of a tripping collar which is set according to the depth of thread desired, and which comes into contact with the face of the work. Several makes of taps are also on the market in which the chasers are collapsed in what is generally known as the "pull off" manner. With these taps the turret is retarded either by hand or by stop-screws, and the action of the chasers in pulling on the threads already cut, operates a cam, which collapses the chasers.

Collapsible taps may also be divided into two other classes, namely, those for cutting straight threads and those for cutting tapered pipe threads. While it is possible to cut tapered pipe threads with a straight-thread tap, and vice versa, it is not common practice to do this. On account of the length of standard pipe threads, and the fact that chasers of sufficient length and having the proper taper are required for cutting them, the chasers in pipe taps are longer than ordinarily required for cutting straight threads. The length of the chasers used is practically the only difference between straight thread and pipe taps.

There are, however, two classes of taps for cutting tapered pipe threads on the market, one using tapered chasers of sufficient length to produce pipe threads of standard taper and length, and another that employs short chasers which are made to recede as the tap is fed into the hole. The

former style requires considerable power to drive, due to the friction resulting from the long bearing which the chasers have, whereas the receding-chaser tap produces a tapered thread in virtually the same manner as a straight thread, and without requiring any more power for driving. This results in power economy, as well as less wear of both the tap and the machine on which it is being used.

Because of these features, the receding-chaser tap can be successfully applied for cutting tapered pipe threads in steel, for which the tapered-chaser tap usually proves impractical and fails to stand up on continuous service. Such work as cast and forged steel flanges, fittings, such as tees, ells, Y's, crosses, etc., oil-well supplies, such as drill and rotary line pipe couplings, casing heads and shoes, tool joints, valve bodies, and numerous similar pieces can be successfully and economically tapped. Records of two minutes have been made in tapping standard length and taper pipe threads in 6-inch forged steel flanges. This receding-chaser tap is also suitable for use on cast iron as well as steel, especially for the larger sizes, on account of the power economy.

Solid adjustable or inserted-chaser taps are so closely related to collapsible taps that they should have a place in this discussion. While these taps must, of course, be backed out, they have many advantages over the ordinary solid taps. Owing to the size-adjusting feature, the chasers can be frequently reground and accurate size maintained, whereas after a solid tap has once been ground, its exact size is lost. This makes these taps especially adaptable for hand sizing work. When the chasers are worn out, they can easily be replaced at about the same cost as a solid tap with the advantage of longer life due to the possibility of grinding. It is also possible to use the same holder for different sized chasers. Usually the chasers in solid adjustable taps are interchangeable with those in collapsible taps of corresponding size.

Chasers for Collapsible Taps

Possibly the most important feature in the success of collapsible and solid adjustable taps is found in the chasers used. These must be very accurately made, a fact to which most manufacturers are keenly alive. The steel is first carefully selected, and usually special heat-treating and hardening processes are used. The chasers are generally hobbed or chased with tools made with the greatest care and to very close tolerances, measured with delicate microscopic instruments to insure threads of perfect form and accuracy in lead. The chasers themselves are subjected to careful inspection and test to insure correct results after they reach the customer. These parts must also be made absolutely interchangeable so that when additional chasers are ordered, after the tool is in service, there will be no trouble in having them fit properly when received by the customer.

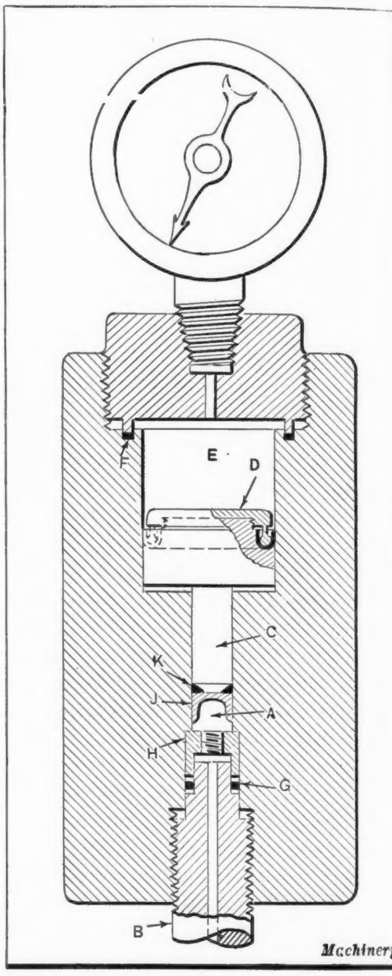
The grinding of the chamfer or the throat and the cutting edges of the chasers is also of great importance, and various types of fixtures and grinding machines are available. The cutting edges must be ground with the proper rake angle for different metals, or poor threads will result. A large percentage of the troubles reported to the manufacturers are traced to improper grinding, and the literature of most manufacturers gives detailed information on this subject. The chamfer or throat angle on all chasers in a set must also be uniformly ground to insure an equal distribution of the cutting strain on all the chasers in the set instead of having a few of them doing all the cutting. This is also necessary to insure cutting a thread that is of the correct lead.

While collapsible taps are becoming more and more commonly used, there is still a large field for their development, and rapid progress is being made toward applying them to different classes of work. The time has passed, however, when they must be considered in the experimental stage, and they have rightfully earned their place among modern production tools.

HYDRAULIC PRESSURE INDICATOR

By JOHN N. SIOUSSA

Difficulty in obtaining a commercial pressure gage for indicating extremely high pressures led to the development of the device here illustrated. This device proved satisfactory for determining pressures of more than 100,000 pounds per square inch. The principle employed is that of reducing the pressure by using differential cylinders so that a commercial pressure gage of a dependable size can be used. The cylinders and plunger of the device have differential areas, in the ratio of 10 to 1.



Device employed in Connection with Commercial Gage to indicate High Pressures

The liquid under high pressure is admitted to the small-area cylinder *A* through a tube *B*. The liquid in cylinder *A* acts upon the small area *C* of the floating plunger, and the large end *D* of the floating plunger, in turn, acts upon liquid confined in the larger cylinder *E*. The reduction in the pressure thus obtained is in the same ratio as the areas of the cylinders located on each side of the plunger. It was necessary to modify the indicator dial by adding a cipher to each of the numbers in order to have a direct indication of the existing high pressure. The gage is secured to the head of the cylinder *E*.

The best material obtainable was used in this device, but even then it was found necessary to make the cylinder extra heavy. A lead gasket *F* is used to seal the cylinder head and the tube so that they will be leak-proof. A lead gasket *G*, with a steel washer on each side, was placed between the gland cup *H* and the shoulder near the end of tube *B*. Leakage around the inner wall of the cylinder and the plunger is prevented by the use of specially treated leather packing. The leather cup packing *J* is restricted by an expanding ring *K*, which compensates for the dilation of the cylinder, when the pressure increases. The U-shaped packing on the low-pressure side of the plunger is of the kind generally employed for hydraulic work. The friction surfaces of the cylinder and plunger are lapped smooth, and the plunger is left free to reciprocate.

* * *

The storage of coal underground at the mines is suggested by the United States Bureau of Mines as a practical step toward the accumulation of the coal reserves necessary to stabilize industry and to protect the domestic consumer in periods of actual coal shortage. The seasonal demand for coal can to some extent be met by storage by the consumer or the distributing agent; but on a large scale, the storage would have to be located underground at the mines, because it is not feasible to provide more than a limited amount of storage above ground.

High-speed Spindle for Screw Machine

In the production of small parts averaging 1/8 inch in diameter, or less, on standard makes of automatic screw machines, a considerable loss in productive efficiency occurs. This loss may be attributed to a number of causes, but the principal one is lack of proper cutting speed due to the comparatively low spindle speeds available. It has been possible to obtain automatic screw machines with a maximum spindle speed of 5000 revolutions per minute, in which the spindle could be started, stopped, and reversed instantly, or practically so. With the spindle running continuously in one direction, a speed of 6000 revolutions per minute could be secured on these machines. However, even these speeds are not high enough for work below 1/8 inch in diameter. In order to handle work of this size the high-speed spindle shown in Fig. 1 was designed and installed in a small bench screw machine. The maximum diameter of work that can be machined with this equipment is 0.100 inch, and the maximum length 1 inch. This machine has produced small screws at the rate of 1600 per hour, including the forming, threading, and slotting operations.

The new design of spindle has been operated eleven hours a day for a period of four months, at a speed of 9000 revolutions per minute. After this usage, the machine was disassembled and examined, and the wear was found to be so slight that the original lapping marks on the spindle had not been obliterated. After the change in design shown in Fig. 2, this spindle was run at a speed as high as 14,000 revolutions per minute on parts requiring a high cutting speed.

When it is considered that the type of bench screw machine which this newer design superseded was never operated at a spindle speed of more than 4000 revolutions per minute, the gain in productive efficiency can be appreciated. Considerable experimenting was done before the final design shown in Fig. 1 was adopted. At first it was thought that lubrication of the bearings should be accomplished by pressure feed, but in practice it was found that lubrication from sight-feed oilers was sufficient.

Construction of High-speed Spindle

Referring to Fig. 1, it will be noted that the spring collet *A* is keyed to the collet sleeve *B*, and is drawn into position by tube *C* which is squared on its rear end to receive a wrench. The spring collet is held stationary longitudinally by locking the head of tube *C* in place by means of a set-screw *D* located in the end-thrust lock-nut *E*. The feed-tube *F* is keyed to the draw-in tube *C*, as it was found that in operating the spindle at high speed the friction of the feed-finger *G* on small diameters was insufficient to rotate the feed-tube with the work. This slippage caused considerable injury to the stock until the key was included, thus insuring positive rotation of the feed-tube.

The spindle is driven from pulley *H* through clutch *I*, which is keyed to the main spindle. Attention is directed to the method of attaching the driving pulley to eliminate end play and to prevent the belt pull from acting on the spindle. The front bushing *J* extends through the front bearing and serves as a rigid bearing for the pulley. A plate *K*, made in halves and screwed and pinned to the pulley, is inserted in a groove in the spindle. When the clutch is disengaged, the pulley runs free on the front bushing. End play is prevented by plate *K*. When the clutch is engaged so that the spindle rotates with the pulley, plate *K* acts as an end thrust bearing and absorbs the force employed to keep the clutch in mesh with the pulley. This allows the pulley to rotate on its own axis without transmitting the side pull of the belt to the spindle.

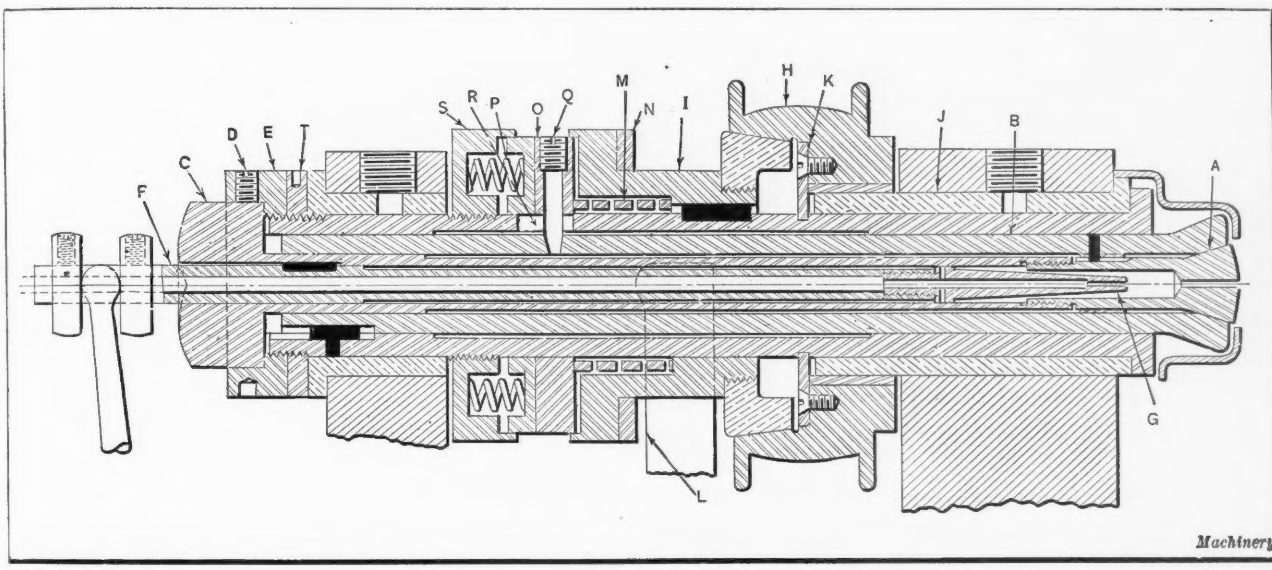


Fig. 1. Sectional View of High-speed Spindle designed for Use on a Bench Screw Machine

Method of Stopping the Spindle

In producing screws, the threading operation is performed by a rotating die held in the turret while the work remains stationary. This necessitates stopping the spindle without opening the chuck. It should be noted that both the stopping of the spindle and the opening of the chuck are performed with one lever *L*. The clutch body is recessed to receive a spring *M*, designed to exert sufficient pressure to properly engage the clutch with the pulley. A friction plate *N* is interposed between the clutch and lever *L*. Plate *N* is prevented from rotating by a pin carried on the head casting, which engages a slot in the edge of the plate.

When lever *L* is operated by the cam that controls it, the clutch is disengaged sufficiently to clear the pulley, and yet not enough to bring it into contact with collar *O* which carries chuck sleeve pins *Q*. Neither is spring *M* compressed sufficiently by this movement to cause springs *P* to be compressed. The friction between plate *N* and the

clutch body caused by lever L is sufficient, however, to stop the spindle in less than one-fourth second. The drop on the cam that controls lever L is designed so that when the clutch engages the pulley there is no friction between plate N and the clutch.

In the operation of opening the collet to feed the stock forward, the lever L carries the clutch back farther until collar O causes springs P to be compressed. It should be noted that pins Q pass through elongated slots R and engage the collet sleeve B. As springs P are compressed, the collet sleeve B is carried to the rear so that the collet jaws are allowed to open. By providing a quick drop on the cam that operates lever L, springs P serve to close the collet instantly after the stock is fed forward. The casing S which contains springs P is threaded on the spindle to permit the adjustment required to obtain any tension that may be necessary to hold the stock securely in the collet.

As the collet does not move during the opening and closing movement of the collet sleeve, accuracy in the length of the piece machined is not affected by variations in the diameter of the stock. It will be noted that the collet sleeve is also keyed to the spindle. The throat angle and collet bearing were ground out after assembling, the spindle being

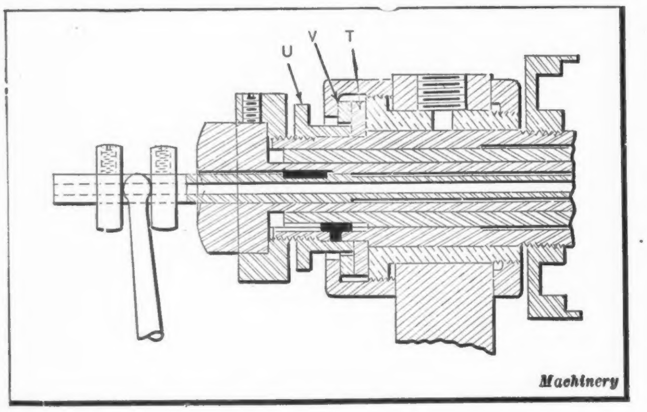


Fig. 2. Rear Bearing of Spindle shown in Fig. 1 with Improved Means of taking up End Thrust

rotated in its own bearing during this operation. The hole in the collet was also finish-ground after assembling, thus securing a minimum of eccentricity, and since all parts are keyed together this condition is maintained.

All the parts are extremely simple, and the only taper-grinding necessary is on the clutch, pulley, and chuck seat. The bearings are made solid with straight holes. Of course, excessive wear means replacement of the bearings, but this is accomplished at a minimum cost. The first machines of this type to be made have been in service two years and the original bearings are still in good condition.

Provision for Taking up End Play

Originally end play was taken up between the head shoulder of the spindle and nut T which was locked in place by nut E. It was found that if the end play was taken up when the machine was at room temperature, inaccuracies appeared in the work after the machine had warmed up due to the longitudinal expansion of the spindle. If the end play was taken up when the spindle was hot from running, it would "freeze" or bind in the bearings over night so that trouble would be experienced in starting the next morning.

This difficulty was avoided by changing the design of the take-up members as shown in Fig. 2. In the improved design, the rear bushing is extended, threaded on each end, and adjusting nuts are fitted to the threaded ends so that longitudinal adjustment of the rear bearings can be obtained. The spindle is provided with an end-thrust collar T, which is securely held in place by nut U and a key, so that it rotates with the spindle. This prevents the spindle from having any play as it rotates between the end of the rear bearing and the end-thrust washer V held by the rear bearing adjusting nut. The head of the spindle is relieved so that there is a clearance between its rear face and the front bearing.

The end play is taken up by loosening the front adjusting nut of the rear bearing and tightening the rear nut so that the end-thrust washer V is brought up against the collar T. While the spindle is left free to expand in length, this expansion does not affect the adjustment for end play. Satisfactory operation in every respect resulted from this improvement.

Experiments with High-speed Spindles

Some interesting experiments have been conducted along the lines of high-speed spindle construction. A speed of 80,000 revolutions per minute has been obtained with an air-driven spindle operating on the turbine principle. These experiments indicate the possibility of considerable advancement in the grinding and drilling of holes through the use of spindles designed to run at speeds heretofore believed impractical.

A test machine was used with a vertical spindle mounted in two cylindrical bearings, the weight of the spindle resting on a ball. The air pressure used in driving the spindle was about 35 pounds. Failure of the bearings and the inability to secure high speeds indicated the need of extremely close dynamic balancing, even on a straight spindle of uniform diameter. By relieving the bearings so that a clearance of 0.030 inch was obtained around the spindle, the fact was revealed that inequalities in the metal of the spindle caused the axis of rotation to be approximately 0.024 inch away from the longitudinal axis of the spindle when the speed of rotation reached 80,000 revolutions per minute. This change made it possible to secure the higher speeds that could not be attained when the bearings fitted the spindle closely. At this speed the spindle spun upright without any means of support other than the ball in the cup depression at the lower end of the spindle, the gyroscopic action being apparent. B. G. C.

* * *

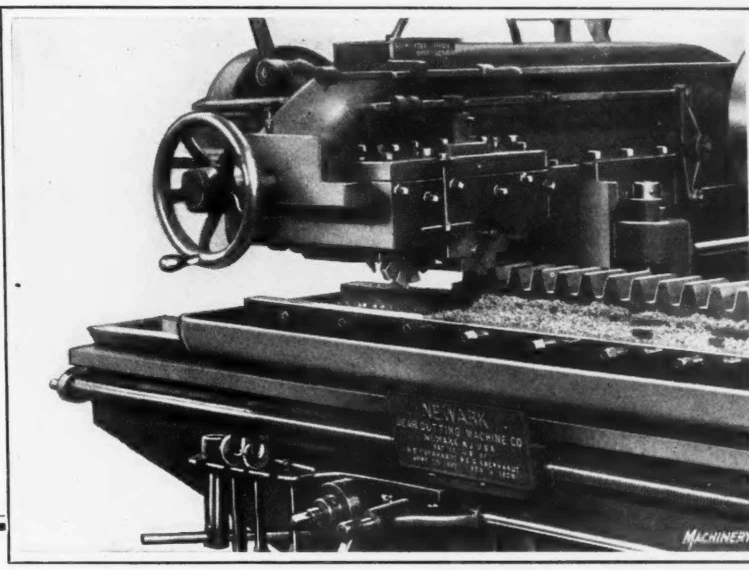
HARD AND FAST RULES ARE EXPENSIVE

By CHARLES W. LEE

Perhaps too many shops are run in accordance with such hard and fast rules—with such an adherence to system—that a good deal of money is spent simply to avoid the use of individual judgment. The writer recently visited a shop where the foreman had a lot of small bolts to make. The bolts were intended to hold some strips of wood together, so that a variation in diameter of 1/64 inch, or more, would make no difference. The foreman took advantage of this fact and rigged up a screw machine with a broad tool in the cross-slide, and turned the bodies of these bolts with one sweeping cut. The superintendent came along and told him to stop using that method and to produce them in the regular way, based upon the rule: "The way to turn work in a screw machine is to rough out with a hollow mill and finish with a box-tool." This method of producing the work, of course, required a much longer time, but the rule was not violated.

In another case, the writer learned of a certain machine that produced more work than a machine formerly used for the same purpose, simply because the new machine was so designed that the work and cutting tool were more easily and quickly handled, and the cutting tool was so designed that it would stand a heavier cut at a somewhat lower speed. This machine was brought to the attention of a man who managed his shop by set rules. He entirely refused to listen, because, as he said, he had been brought up to believe in quick speeds and light cuts. Somebody once said something about consistency being a virtue of certain minds, and the writer begins to believe he was right.

Rack-cutting



General Practice in Cutting Racks on Machines Designed for this Work

By FRANKLIN D. JONES

RACK teeth are cut ordinarily by milling with a formed cutter, although in some shops they are cut by planing with a formed tool. While the teeth of racks may be cut by a generating method, this has been applied to a limited extent only. The milling process is employed much more than any other for commercial rack-cutting. The rack teeth are produced either by feeding a formed cutter across the rack blank or by causing the rack to feed past the cutter. After milling each tooth space, either the rack or the cutter is indexed an amount equal to the linear pitch of the rack teeth (or circular pitch of the mating pinion) except when two or more finishing cutters are used, as explained later.

When racks are cut on ordinary milling machines, the feeding movement is, of course, applied to the work-table and rack. Special rack-cutting machines have been designed along similar lines, with certain features introduced to make them more efficient and better adapted for cutting racks on a quantity basis. Other rack-cutting machines are arranged to hold the work stationary, except for the indexing movement, and the cutter-slide is given a feeding movement.

Racks are frequently cut on planers, especially where the number required does not warrant installing a special machine, and shapers may also be used for relatively small sizes. When a planer or shaper is used, it is common practice, except for small pitches, to first rough out the teeth by cutting rectangular slots, and then finish the rack teeth with the tool ground to the correct angle and width at the point. This planing method, however, is utilized in connection with standard planing machines and has not been applied to commercial rack-cutting machines which are designed for milling the teeth with formed cutters.

Most of these special rack-cutting machines operate automatically except for the insertion and removal of the work. After the rack to be cut has been placed in position and the machine is properly adjusted, all the teeth are cut without further attention on the part of the operator. The indexing movements between successive passages of the cutter are controlled through change-gearing which may be arranged to transmit motion from a "one-revolution" shaft (which revolves only when an indexing movement is required) to the lead-screw through which the position of the work-table is shifted.

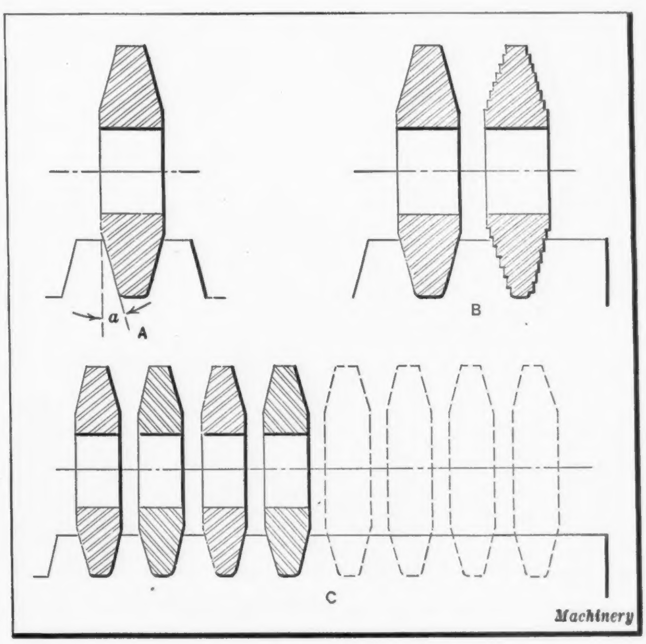


Fig. 1. Different Methods of milling Rack Teeth

General Shape and Proportions of Rack Teeth

Rack teeth for the involute system of gearing have straight sides (subject to certain modifications, as explained later) which incline at an angle a (see diagram A, Fig. 1) equal to the pressure angle of the gearing. For instance, if the pressure angle is 14½ degrees, as is generally the case, the included angle of the rack teeth will be 29 degrees. Incidentally, this straight-sided rack tooth is an important feature of involute gearing, because it simplifies the making of cutters for producing gears by generating processes.

While involute rack teeth theoretically have straight sides, in practice the teeth may be straight except for a slight curvature at the points to avoid interference, such, for example as would occur between perfectly straight teeth of the full length and a pinion that is too small. The amount of interference increases as the number of teeth in the pinion decreases, and begins with 31 teeth when the pressure angle is 14½ degrees. If the pressure angle is 20 degrees, interference begins with 17 teeth. Straight-sided rack teeth are sometimes shortened to avoid this interference, a certain amount being removed from the tops of the teeth. Another method is to simply round the corners of the teeth. A modification in rack tooth forms is obtained when the teeth are milled with a regular No. 1 cutter, which is common practice. Since this cutter is intended for involute spur gears including all numbers of teeth from 135 to a rack (which may be regarded as a spur gear of infinite radius), the shape of the cutter is necessarily a compromise, and when applied to a rack it forms teeth having curved sides. This curvature is sufficient to prevent interference under ordinary conditions.

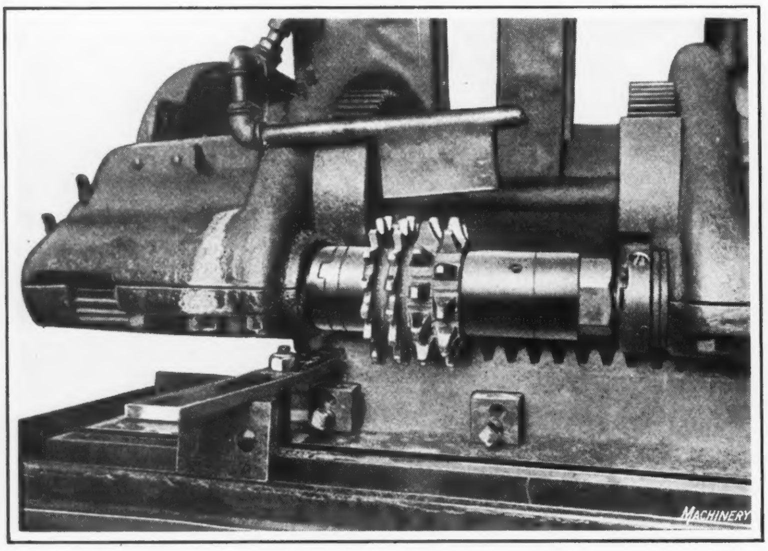


Fig. 2. Machine equipped with a Gang of Two Roughing and Two Finishing Cutters

Aside from any change in the height of the tooth to avoid interference with a meshing pinion, rack teeth are made to the same dimensions as spur gear teeth of equal pitch. The whole depth equals 2.157 ÷ the diametral pitch, or it may be found by multiplying the circular pitch by 0.6866. The linear pitch of the rack, or the distance from the center of one tooth to the center of the next one, is the same as the circular pitch of the pinion that is to mesh with the rack. The tooth width at the pitch line equals one-half the linear pitch, and the vertical distance from the top of the tooth to the pitch line equals the linear pitch times 0.3183. The latter dimension would be used in setting the vertical scale of a vernier gear tooth caliper, assuming that the latter were employed for measuring the tooth width.

General Methods of Cutting Racks by Milling

Racks may be milled either by using a single cutter or by the use of gang cutters consisting of two or more cutters on the same arbor. Diagram *A*, Fig. 1, illustrates the single-cutter method. Each successive tooth space is formed by this cutter, and the rack is indexed an amount equal to its pitch after each space is milled. Diagram *B* indicates how roughing and finishing cutters are often used together. The roughing cutter, which should preferably be of the stepped form to break up the chips, is mounted on the same arbor as the finishing cutter and precedes the latter. Roughing cutters which simply mill straight-sided slots are sometimes used instead of the stepped form.

The lower diagram *C* illustrates the application of a gang of finishing cutters, which is used to mill four tooth spaces simultaneously. The cutters are spaced on the arbor to suit the pitch of the rack to be cut, and the indexing movement between successive cuts equals the number of cutters in the gang multiplied by the linear pitch of the rack. In one shop where this method has been employed, the number of cutters used in a gang is made equal to the diametral pitch of the rack. For example, if the rack is of 4 diametral pitch a gang of four cutters is used. Where racks are cut by the gang method, it is applied, as a rule, to the smaller pitches.

Operation of Commercial Rack-cutting Machines

The cutting of a steel rack of rather large pitch is shown in the heading illustration. The machine employed is a Newark rack-cutting machine. The cutter-slide of this machine is given the feeding movement, being traversed by a reversing screw driven through forward and return clutches. These clutches are controlled by adjustable dogs which govern the length of the stroke. The indexing of the work-table occurs automatically at the end of each stroke of the cutter-slide, and is regulated by a suitable combination of gearing, through which motion is transmitted to a screw connecting with the table. The indexing mechanism is equipped with a "stop gear" having an inserted tool-steel notch engaged by a stop-lever. This device serves to lock the mechanism and accurately locate the work, irrespective of lost motion in the change-gearing. A vertical adjustment is provided for the work-table to permit setting the rack blank at the proper height relative to the cutter.

Fig. 2 shows a rack-cutting operation at the plant of the Simonds Mfg. Co., Pittsburg, Pa. It will be seen that in this case, two roughing cutters precede two finishing cutters, and two teeth are milled at each passage of this gang of cutters, the work being indexed after each cut an amount equal to twice the linear pitch of the rack. This rack has a face width of 1½ inches, and the teeth are of 3 diametral pitch. The material is mild machine steel. The two gashing cutters are ⅜ inch wide, and mill straight-sided slots which are about the same width as the points of the forming cutters. The cutters have a feed of 1 inch per minute.

The cutter-spindle of this machine is driven from each end. The work-table is indexed after each cut, and the saddle beneath the table is given a lateral feeding movement along the knee which supports it. The knee is adjustable vertically for setting the cutters relative to the rack. The arrangement of the table with its saddle-supporting knee is similar in construction to the ordinary column-and-knee type milling machine. The indexing mechanism may be arranged either for single indexing, or for multiple indexing, as required when employing the gang method of rack cutting.

Gang cutters are used for the finer pitches, the number in a gang depending on the pitch. The change-gears ordinarily furnished with this machine are based on diametral pitches, but gearing for cutting circular pitches may be obtained. Aside from inserting and removing the work, this machine is automatic, including the feeding and index-

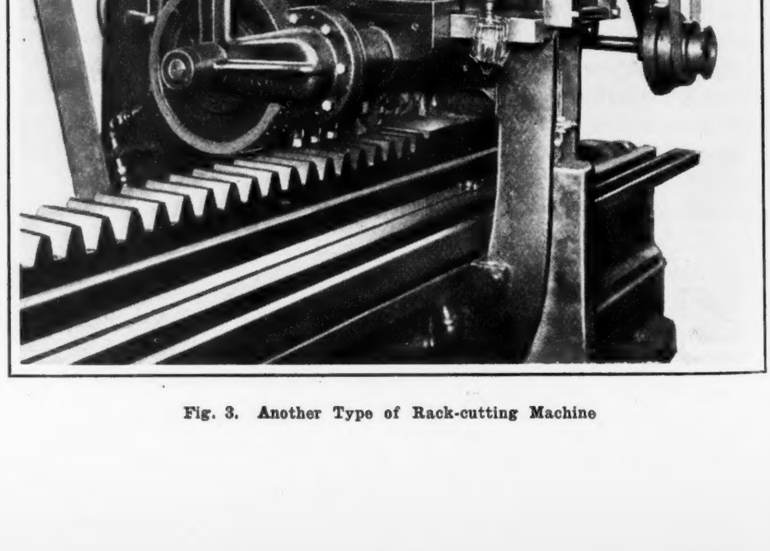


Fig. 3. Another Type of Rack-cutting Machine

ing movements, as well as stopping of the machine, either at the end of the table travel or at any point within the range of the movement.

A rack-cutting machine designed somewhat along the lines of a planer is shown in Fig. 3. The rack to be cut is mounted on a horizontal table which indexes after each passage of the cutters, and the cutter-slide is given a crosswise feeding movement for milling the teeth. For the particular rack-cutting operation illustrated, a gang of three cutters is used, there being two roughing cutters and one finishing cutter (see the detail view, Fig. 4).

The work in this case is a cast-steel rack, having a linear pitch of 2½ inches and a face width of 6 inches. The first cutter makes a channel 1 1/6 inches wide by ⅞ inch deep. The second gashing cutter increases this depth to 1 13/16 inches and the width to 13/16 inch, leaving only a small amount of stock to be removed by the finishing cutter. A feed of ⅝ inch per minute is used, and one tooth is finished at each passage of the cutters. This machine has been used for cutting teeth as large as 3½ inches linear pitch, and as small as 8 diametral pitch. For 8 diametral pitch, six finishing cutters are used at once, no gashing or roughing cutters being used. For 4 diametral pitch, four gashing and four finishing cutters are used. The machines shown in Figs. 2 and 3 were made by the Walcott Lathe Co., Jackson, Mich.

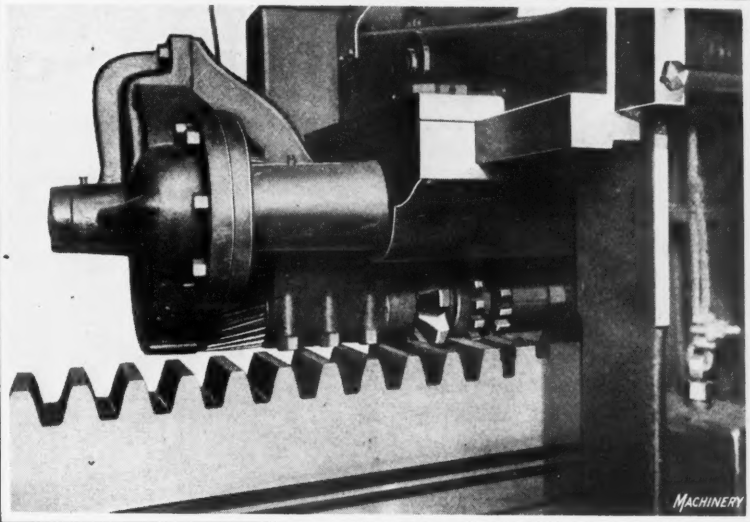


Fig. 4. Close-up View of Rack-cutting Operation shown in Fig. 3

Rack-cutting on Machine of Vertical Design

The rack-cutting machine shown at work in Fig. 5, is a vertical-cutting type, made by Gould & Eberhardt, Newark, N. J. The cutter-slide feeds vertically along the face of the column, and the rack is held in a vertical position by a multiple type of clamping fixture, similar to a series of machine vises. With this arrangement the thrust of the cut is taken directly by the machine table and bed, and the chips fall freely from the cutter.

Adjustment of the work-table along the bed is provided for setting the work relative to the cutter. The indexing movements of the table are automatic, and the mechanism may be arranged either for single spacing or for multiple spacing, as when using gang cutters. An adjustment with micrometer graduations enables the work-table and rack to be moved slightly without disturbing the indexing change-gears. This adjustment is convenient when milling a long rack in sections. The particular machine shown in Fig. 5 is cutting a steel rack having a pitch of 1¼ inches, a face width of 12 inches, and a total length of 56 inches. Sometimes two or more racks are cut simultaneously, by placing a stack of blanks between the jaws of the multiple fixture.

Generating Rack Teeth

Rack teeth may be formed by a generating process, as when using a Fellows gear shaper equipped with a suitable attachment. This attachment consists mainly of a work-table or slide mounted in the horizontal ways of a guiding frame. A rack on the slide engages a pinion secured to the work-spindle. The rack to be cut is attached to the horizontal slide; consequently, when the work-spindle and cutter are rotated at the proper ratio through change-gearing, the pinion on the work-spindle causes the work-holding slide to move along just as though the rack being cut were in mesh with a pinion corresponding to the cutter, which has a rolling and reciprocating motion the same as when generating the teeth of a spur gear.

* * *

HEAT-TREATMENT OF GAGES

The ordinary type of working and inspection gages employed in interchangeable manufacturing work are made by several large companies from low-carbon cold-rolled steel containing from 0.15 to 0.25 per cent carbon. Gages made from this steel are carburized, permitted to cool, reheated for hardening, and quenched in oil. The carburizing temperature is about 1450 degrees F., and for gages of the ordinary size met with in the manufacture of small machine mechanisms, the time the gages are left in the carburizing furnace is about five and a half hours. After having cooled down, the gages are repacked in packing material that has previously been used in the carburizing process and that is therefore partly spent. The reheating temperature is about 1400 degrees F., which is maintained for about five hours, after which the gages are hardened by quenching in oil. Thread gages are drawn after hardening, to a temperature of about 375 degrees F.; those having a sharp V-thread are drawn to a temperature of 400 degrees F. The higher temperature for the sharp V-thread gages prevents brittleness on the extreme sharp top of the thread, which is likely to become quite hard when quenched in the hardening operation.

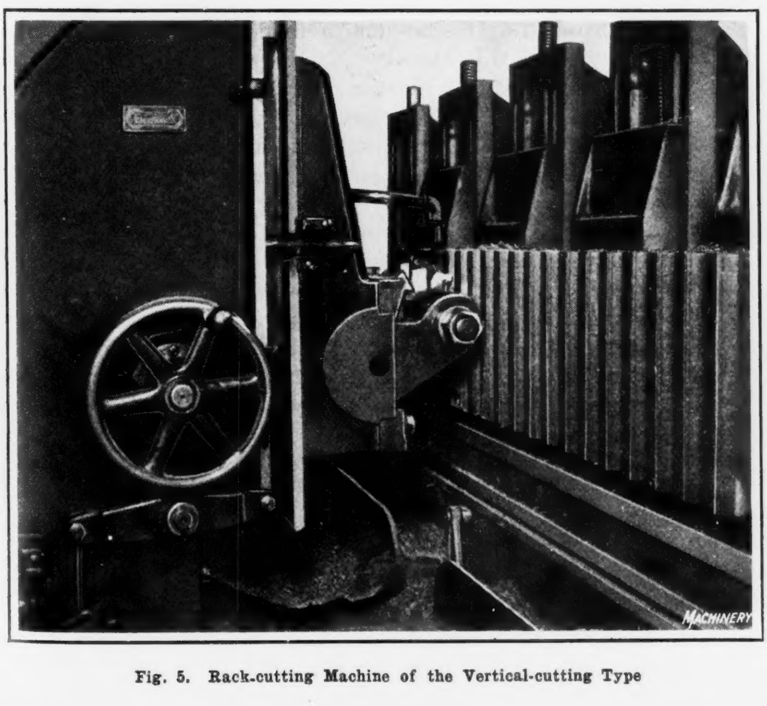
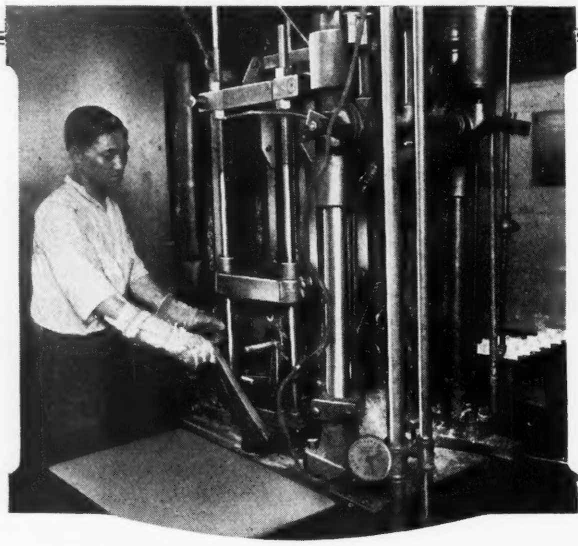


Fig. 5. Rack-cutting Machine of the Vertical-cutting Type

Design of Die-casting Dies

By CHARLES PACK, Vice-president and Chief Metallurgist, Doehler Die-Casting Co., Brooklyn, N. Y.



THE die-casting process tends to produce a casting less dense than the original metal, and in this respect is diametrically opposite the drop-forging process. In producing die-castings, the formation of blow-holes must be constantly guarded against, and this must be given serious consideration in the design of every part to be die-cast, as well as in the construction of the dies. There are a number of conditions that give rise to blow-holes in die-castings, the four principal ones being (1) drossy or porous metal; (2) the presence of air in the die; (3) rapid chilling of the metal around the inner cavity of the die, preventing the metal from completely filling the mold because of the solidification; and (4) piping.

Much has been done to eliminate blow-holes in castings, but with varying results. The vacuum process is one method that has been tried in an effort to produce sound castings. This process is based on the assumption that blow-holes in die-castings are always due to air entrapped in the die, and consists of exhausting the air as a means of eliminating the blow-holes. In practice it has been found that this hypothesis is not correct. It is evident that the vacuum process would not prevent the formation of blow-holes due to drossy metal or to piping.

The third cause of unsound castings, namely, the rapid cooling which prevents completely filling the dies, cannot be corrected by the vacuum process, as a simple diagram will demonstrate. Such a diagram is shown at *D* in the line illustration in which there are two sections of unequal size connected by a comparatively narrow section. The metal, as before stated, flows around the walls of the die cavity, and chills, so that in a design similar to this, the connecting section has an opportunity to freeze solid before the larger section is filled. Since the metal can no longer be forced through, a void or cavity results in the section of greater area. The chilling of the metal around the walls of the die cavity closes all vents and makes it necessary for this void to fill in from the inside, leaving a porous section (blow-holes) in the center of the larger section, as indicated in the diagram.

The vacuum process is not the means for preventing blow-holes arising from any of the four causes previously mentioned, with the possible exception of the second cause—air in the die. It is possible, however, by the careful location of the gate through which the metal is fed to the die and by providing suitable vents, to produce a casting that is practically free from blow-holes. On a part of irregular shape, it is often possible to concentrate on one particular portion and produce that part free from blow-holes, but the same practice applied to another part of different shape will not necessarily produce a solid casting. The conditions shown in diagram *D* could be overcome by relocating the gate and feeding the metal through suitable passages to both large portions.

The proper placing of the gate, in designing the die, will also save much trouble in finishing that particular die-casting. The location of the gate may affect the appearance of the product, because the metal connecting the casting with the gate must be ground or filed off. The gate should not be connected with any portion of the casting where such filing or grinding will impair the appearance of the article. Two examples of this are shown in the illustration. The window regulator *C* for an automobile is of an ornamental design, the contour lines of which must be preserved, so the gate could not be placed at any portion that is exposed to view. By placing the gate on the under surface that comes next to the automobile door, subsequent finishing may be performed without affecting the appearance of the finished piece.

Another example in which the appearance of the part is affected by the location of the gate is the aluminum French heel shown at *A*. In this case the gate is located on the tread, where subsequent removal can be accomplished without defacing the contour of the casting. The placing of the gate on any other portion than that indicated would not only result in the disfigurement of the casting, but would also cause some difficulty in removing the connecting metal.

Importance of Proper Venting

Venting may be accomplished in a number of different ways. The simplest method is to plane a strip about 1 inch wide, and from 0.005 to 0.010 inch deep, on one of the dies at the parting line. Another method of venting often resorted to in dies of intricate design consists of using slabbed or loose-fitting ejector-pins in round holes, which provides for the escape of the air.

A part having a number of thin projections, the corners of which must be kept sharp, is shown at *E*. It is obvious that air would be trapped in the parts of the die forming these thin sections, if proper vents were not provided. If the air can be expelled, the metal will fill these narrow sections completely and the projections can then be cast with sharp corners. In this case, sufficient vent will be afforded by simply driving in pins opposite these sections. The space between each pin and hole will permit the air to be forced through by the metal even though this space is not greater than that required for a light driving fit. The location of gates, parting lines, cores, as well as information regarding other details of die construction, can be best learned from an inspection of a number of dies. Examples of dies illustrating good practice in regard to these various points will be shown in a later article.

Factors Influencing the Cost of Die-casting

The cost of die-castings depends on the material used and the quantity to be made. Dies of aluminum castings have a much shorter life than dies for other white metal castings.

Pound for pound, aluminum is about two and a half times as expensive as other white metals, but its specific gravity is so much less that the same volume will produce two and a half times as many castings as the heavier alloys. The comparative cost of die-castings is not, therefore, greatly affected by the cost of the metals alone; but the kind of material cast does have an important influence on the life of the dies, and the length of life, in turn, is reflected directly in the cost of the castings.

The die cost, which is distributed over the quantity of castings produced from each set of dies, is evidently affected by the number of impressions (whether single or multiple) in the die. A single-impression die has a lower initial cost, but will add more to the cost of the casting than a multiple die, owing to the fewer number of castings produced in a given time. Die-castings cannot be considered economical when only small quantities are required; in fact, according to the Doehler experience, it has been found that there is seldom any saving realized over other methods of production where the quantity is less than one thousand.

Factors Affecting the Life of Dies

Dies for making zinc, tin, or lead die-castings will last almost indefinitely, if properly constructed, while those for making aluminum castings will produce from 30,000 to 100,000 castings before they need to be discarded. The difference in length of life is due to the difference in casting temperature. The melting point for aluminum is about 1300 degrees F., or 500 degrees higher than for any other white metal. The effect of this higher temperature on the die is destructive, so that to prevent its rapid deterioration recourse must be had to artificial means of cooling. As previously stated, all dies for bulky castings made of any alloy (also large cores) often require cooling.

When the casting is removed from the die, the temperature of the die impression is lowered, so that when the hot metal is admitted it will be properly chilled, which is necessary for producing a satisfactory die-casting. This repeated heating and cooling of the dies is what is so destructive to the die surface. In time, the fatigue point of the steel is reached, and checks appear on the surface of the impression. This results in castings having imperfect surfaces, and the dies should be discarded when this condition is reached. In the case of white metals other than aluminum, however, the difference in expansion and contraction is not so great, due to the lower melting temperature, and hence such severe strains are not imposed on the die metal.

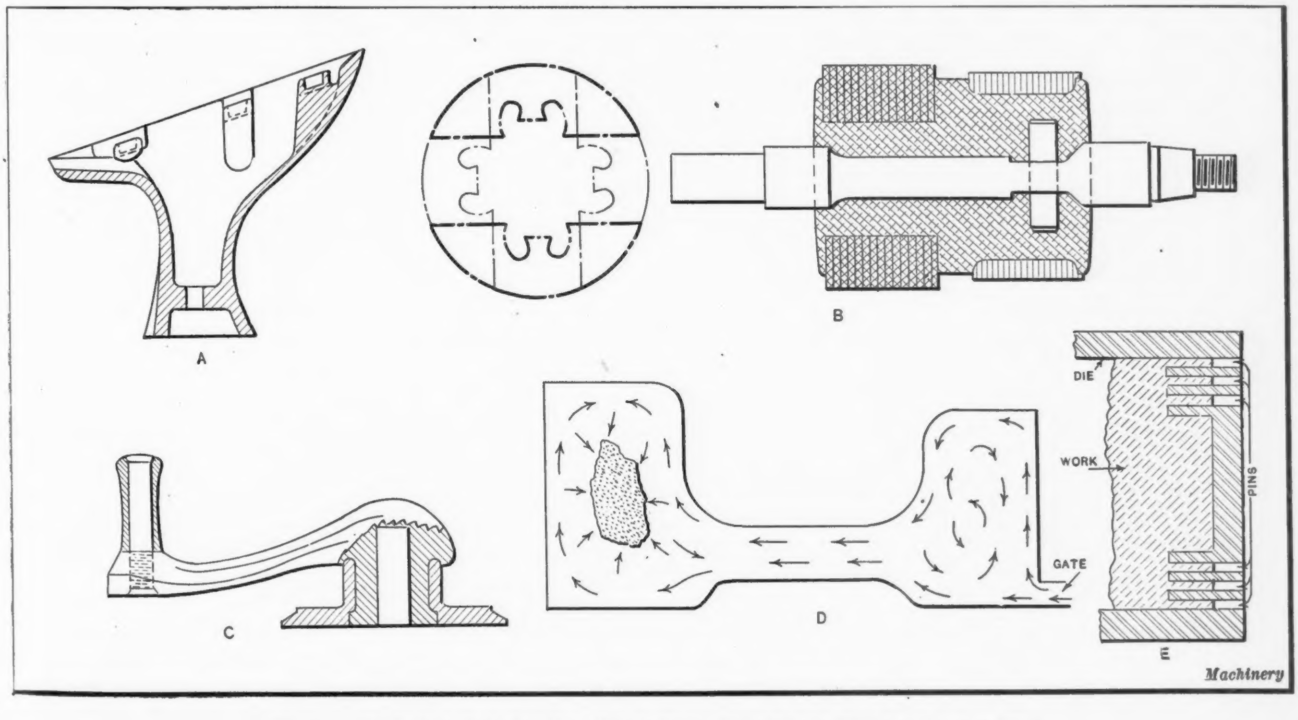
This problem has been partly solved by the compounding of a steel that would stand repeated expanding and contracting. Chrome-vanadium steel of a special analysis gives satisfactory results after being heat-treated to prolong its elastic limit, for it is the elastic limit that governs its resistance to the casting strains. It may be stated that alloy die steels have done more to make the casting of aluminum feasible than any other single factor.

Brass and bronze castings can be die-cast, the same as aluminum, but with limitations due principally to the failure of the steel at the higher casting temperatures. The inability of any steel to withstand this high temperature has so limited the production of brass and bronze die-castings made in metal molds, under pressure, that this process is at present commercially impractical. There is a method of casting these metals which is commercially practicable, but it is a gravity pouring process rather than a pressure process.

Dies designed to produce articles of a rather uniform section, where the amount of metal in each part of the die is about the same, will have a much longer life than where the design requires much more metal in one portion than in another. For example, consider a spider with a hub: There is much more metal at the center than in the arms, so that consequently there is more concentrated heat at this part of the die than in those parts forming the arms. The unequal expansion and contraction due to this condition would have a serious effect on the life of the dies.

Accurately Sinking the Die Impression

In machining the dies, warpage may occur if special precautions are not taken. Warpage may be minimized by first obtaining a steel that has been properly forged and not over-worked at the steel mill. The steel should be free from segregation. After the die-block has been attached to the machine, clamping strains are likely to be set up, and it is often necessary to relieve these strains after most of the machining has been completed, by means of heat-treatment. Otherwise, the dies may warp when released. The heat-treating must be carefully performed, because warpage is again likely to occur if this is not carefully watched.



Diagrams illustrating Gate Location, Insert Work, Formation of Blow-holes and Venting

Hogging out of the metal may be done accurately on any standard milling machine or shaper, but where there is much die work to be done, automatic machines are usually preferable. The Keller mechanical engraving machine is used at the Doehler plant. It is especially useful for sinking impressions in replacement dies, using the old impression as a model; that is, in place of the regular plaster-of-paris model commonly used, the old die itself is employed, and the stylus point follows the die impression. The stylus point causes the frame on which it and the milling cutter are carried, to swing in or out according to the contour of the master impression.

Die-castings with Inserts

Die-castings are often made with steel or brass inserts. These inserts are placed in the die at the time of casting, and the process involves no special feature except that the inserts are usually knurled or provided with some other means of anchoring them in the molten metal. The principal purposes of inserts are: (1) To lend added strength; (2) to furnish electrical or mechanical properties; and (3) to simplify assembly.

A good example of the use of inserts for adding strength and mechanical properties to a specific section of a casting is the window regulator shown at *C* in the illustration. This casting also is an example of insert work for facilitating the assembling of the arm with the hub. There are three distinct parts to this unit, all made by die-casting, and assembled during the process. The hub member is a separate casting, and is used as an insert in casting the complete article. The arm is free to turn within the hub, the latter being coated with a composition of graphite and molasses to prevent the metal from adhering to it when the handle portion is being cast around it. The construction of the hub is such that the handle is assembled within the hub (similar to a spun rivet) and cannot be removed without breaking the casting.

The threaded steel pin for the handle is also cast in the arm at the same time, and a graphitic lubricant used on the extending end to prevent the metal adhering to the handle. The part is placed in a vise after removal from the dies, and given a slight twist with a wrench to disengage the metal adhering to the insert, where it is exposed at the end, after which it will rotate around the insert. This gives the needed strength at this portion.

The use of inserts for adding special electrical properties is exemplified in magneto housings in which are cast the laminated field pieces; also in magneto rotors, such as shown at *B*. The field pieces consist of steel laminations riveted together, which are placed in the die, after which the metal is cast around them. In the rotor illustrated, it will be seen that there are four assemblies of these laminations, two arranged opposite in pairs at one end, and the other two similarly arranged at the opposite end, but at right angles to the other two, as the diagram shown in broken lines indicates. The rotor shaft is also cast in place, and it has a driving pin assembled in it to prevent the rotor body from turning on the shaft.

A common practice is to cast inserts at specific points to provide bearing surfaces. This is often done in housings for magnetos. The magneto housings are also sometimes of such design that special means for lubricating are necessary, and it is common practice to cast in oil-tubes, bent in almost any shape, to provide accessibility for lubricating.

* * *

Shipments of railroad locomotives from the principal manufacturing plants increased to 282 in March, and were the highest since December, 1920, according to figures published by the Department of Commerce from compilations of the Bureau of the Census.

SEASONING CAST-IRON PISTONS

In reply to a question as to the value of heat-treating and seasoning piston castings in the rough, in order to make them easier to machine and to relieve them of strains so as to keep them from warping after they are finished, the Journal of the Society of Automotive Engineers collected directions from a number of manufacturers on this subject. These directions are of considerable value as regards the seasoning not only of cast-iron piston castings, but also of similar castings for other purposes. One manufacturer makes the following statement: "For practical production work, it has been our practice to heat-treat or anneal the pistons after the roughing cut at as low a temperature as possible, that is, not over 750 degrees F. After annealing, we grind or take a light finishing cut before grinding. I do not think this method is as good as ageing before the finishing process, but it is more practical as a production method."

Another manufacturer writes as follows: "We have had intermittently considerable experience with the treatment of gray iron for pistons, and feel that the highest grade product is made from castings that have been subjected to a preliminary tumbling process in the foundry cleaning room and then for a period of about six weeks to a yard-seasoning, where the castings are exposed to the elements. Such castings are not so easy to machine as those that have been heat-treated from the standpoint of annealing. When time will not permit yard-seasoning, we resort to heat-treatment. We find that the castings cut much more easily, but the metal becomes somewhat lifeless from the standpoint of resilience, and a slight bump or shock of the finished piece will cause a permanent set, which is not the case with castings that have been yard-seasoned only. It has been our experience that change of shape in the engine is prevented by sufficient yard-seasoning, as well as by heat-treatment. Either method may be used, but we prefer seasoning."

Another engineer states: "It is my opinion that pistons for internal combustion engines should be heat-treated. In the first place, light weight pistons must be made of very strong iron which almost approaches steel castings. Inasmuch as the combined carbon depends upon the rate of cooling, and the graphitic carbon is very much less than in ordinary cast iron, piston castings, especially the thin sections, are likely to chill or harden in the mold, and thus become difficult to machine. For that reason alone, piston castings should be annealed. Furthermore, even with the most thorough annealing, some internal strains may remain; therefore, for a first-class job, pistons should have an additional treatment between the roughing and the finish-machining processes, in order that they may keep a permanent form after the last finish-grinding."

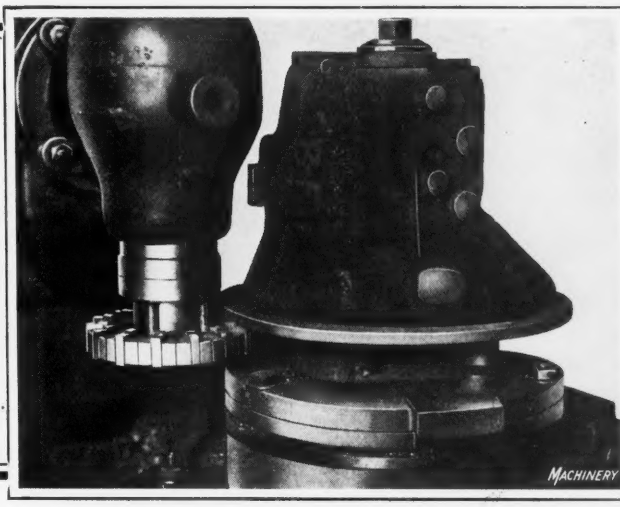
A fourth opinion is as follows: "The main purpose in heat-treating is to relieve the internal strains. Our present method for doing this is as follows: The pistons are first rough-turned, packed in boxes or containers which hold about twelve pieces each, and then placed in a furnace that has been brought to a temperature of 1450 to 1500 degrees F., the heat then being turned off. The procedure of preheating the furnace was found necessary to eliminate the scale that would otherwise form on the exterior due to flame contact. The pistons are allowed to remain in the furnace from 2 to 2½ hours, after which they are removed and cooled in the air. After this treatment, the pistons present a bluish tint in the way of discoloration. Our old practice on larger sizes was to place the pistons in the furnace as received from the foundry. The heat was then applied and the contents heated to a cherry red, when the flame was turned off and the pistons allowed to cool in the furnace. This was more of an annealing process, but we found in some instances that the castings were too soft to conform to our standard."

The Bureau of Standards recently started an investigation on this subject, but no data are as yet available.

Milling With Stellite Cutters

Directions for Obtaining the Best Results and the Highest Efficiency in Using Stellite Milling Cutters

By C. W. METZGER, Haynes-Stellite Co., New York City



THE best peripheral cutter speed for roughing cast iron or semi-steel with stellite cutters on a line type machine feeding in a straight-line direction is 100 feet per minute, and on a rotary type or a drum type machine, 120 feet per minute. For the second or finishing cut on any type of machine, 170 feet per minute is recommended. In some cases, on light castings, speeds up to 195 feet per minute have been used. When only one cut is taken, using a straight-line feed machine, stellite cutters should be run at 125 feet per minute; for the rotary and drum-type machines a speed of 150 feet per minute should be used.

The rate of table travel depends on the peripheral speed, and is usually from 0.010 to 0.015 inch per tooth, although sometimes, according to the material milled, a table travel of 0.030 inch per tooth has been employed. These figures vary, because neither the work nor the fixtures are always rigid enough to withstand, without springing, the pressure caused by the feed which otherwise could be used.

These speeds and feeds demand a rigid machine with a steady powerful drive. Many of the earlier designs of milling machines were not intended for such operative speeds as are permissible with stellite, so that sometimes it has been necessary to depart from the recommended speeds, to obtain the best results without changing over the drive and the spindle mountings. When it is necessary to reduce the speed, the conditions can be improved by grinding the cutter blades to a special form, as explained in the article entitled "Stellite Cutters for Milling" in April MACHINERY. Modern types of production milling machines, whether of the rotary or straight-line design, are usually capable of supplying the power demanded, and can be operated to give the best results with stellite milling cutters. Since stellite cutters do not burn under high speeds, the life of the cutters is long, and no breakage of cutter teeth, machine parts, or work will occur if the machine is in proper condition.

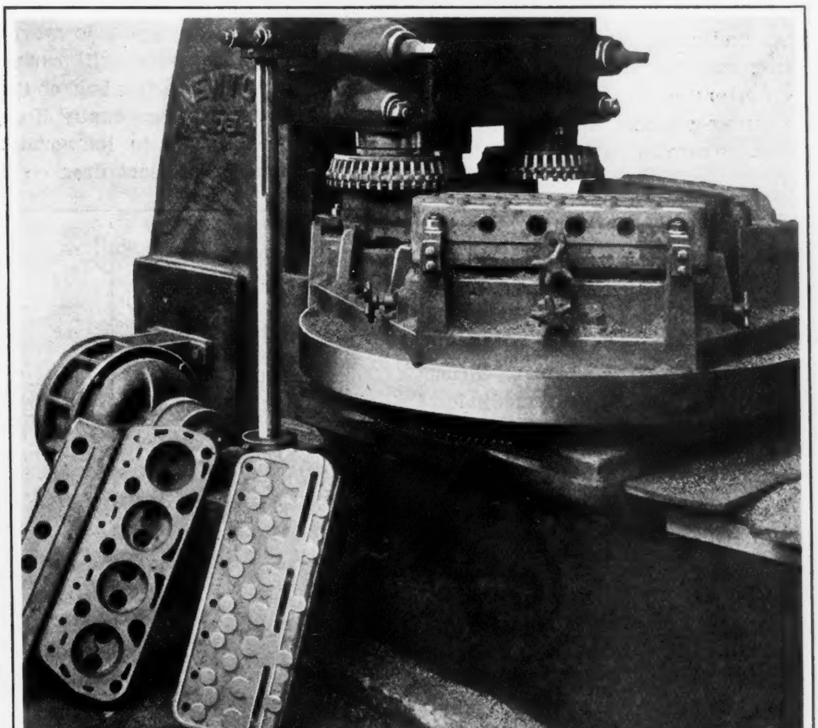


Fig. 1. Milling with 14-inch Cutters, One Roughing and One Finishing, 40 Stellite Blades Each; Speed, 117 Feet per Minute; Table Travel, 12.8 Inches per Minute, or 0.010 Inch per Blade; Depth of Cut, 1/8 to 3/16 Inch; Surfaces per Grind, 519

Conditions of the Milling Machine and Cutter

As stellite operates best at high speeds, it is essential that special attention be given to the condition of the milling machine used. Satisfactory production cannot be expected from a machine that is not in first-class condition. The present article will point out the most common difficulties met with, where trouble should be looked for, and how the conditions can be remedied. If the causes of unsatisfactory work were known, the conditions of the machines in many plants would be remedied, and the obstacles in the way of greater efficiency would be removed.

Three of the most common causes of poor results in milling are due to improper fit of the spindle, condition of the arbor, and mounting of the cutter. The following questions cover the most important points that ought to be looked into before the machine is started on high-production work with stellite cutters.

1. Is the spindle straight?
2. Are the bearings worn or out of round?
3. Is the face of the spindle true and clean?
4. Is the arbor straight and does it fit properly?
5. Is the end of the arbor true and clean?
6. Is the thread on the arbor a good fit for the clamping nut?
7. Have the adjustments for the spindle bearings been set too tight or too loose?
8. Is the back of the cutter clean and square with the arbor hole?
9. Do the cutter blades cut on the periphery?
10. Is the cut deep enough to enable the blades to get under the scale?
11. Are the spring supports under the casting of suitable design and are they adjusted correctly?

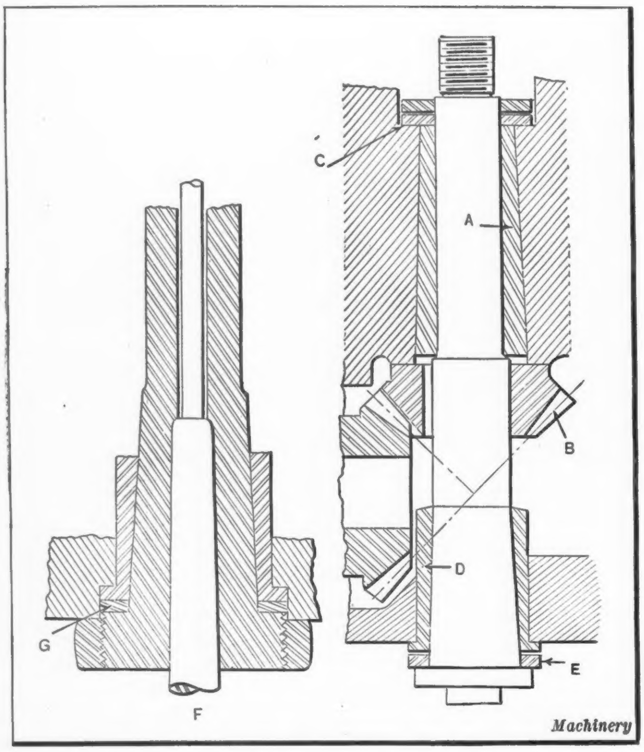


Fig. 2. Diagrams of Milling Machine Spindle Mountings

12. Does the operator stop the machine with the blades in the cut and the feed engaged?

13. Can the machine furnish the proper speeds and feeds?

14. Is the machine sturdy enough to deliver constant power at high speeds?

15. Have the gibs been adjusted?

16. Is there lost motion of the table due to loose gears, screw, or nut?

17. Do the cutters receive painstaking attention in the grinding department, and are they inspected and handled with care?

18. Do the blades fit the cutter body?

19. Do the clamps seat evenly on the blades and hold them firmly against the uneven thrust of the cut, hard spots, etc.?

20. Are the blades broken under the clamps?

The details on the milling machine that require careful attention must also be given attention on the cutter grinder. In fact, negligence in the cutter-grinding department may undo all that has been gained by care in putting the milling machine in first-class order.

Unsatisfactory Fit of Spindle Bearings

In order to obtain maximum results from milling machines when stellite cutters are used, it has been found necessary by those who have thoroughly investigated the matter to align the machine bearings; change the speeds and feeds; make suitable adjustments of bearings, thrust collars, etc.; provide for overhang of arbors; remedy lost motion and backlash of gears; give special attention to the design and care of the cutters; and in fact instruct operators as to the correct way to handle the work.

The diagram Fig. 2 shows a typical spindle design for a vertical milling machine. Side or end play of the cutters produces a rough finish and shortens their cutting life. When the straight bearing of the spindle is loose in bushing *A*, the drive on bevel gear *B* will force the spindle to one side of the bushing, out of line with the taper bushing, and if this is allowed to continue, the bushing will become worn, so that the spindle cannot be adjusted correctly. If this condition becomes pronounced, the cutter will have a tendency to gouge into the work and leave tool marks on the surface.

The thrust collar *C* at the end of the spindle should be of uniform thickness, and should be a few thousandths inch over size, say 0.005 inch, to furnish the necessary space for lubricating the taper bushing and prevent it from heating. Since it is practically impossible to eliminate all end play and still have the spindle operate freely, it is evident that this collar should be well lubricated and in good condition, otherwise the uneven pressure of the cut will cause it to wear, resulting in excessive endwise movement of the spindle and in chatter.

If the bushing *A* is not in accurate alignment with the taper bushing *D*, the operator may be unwise enough to try to correct the condition by making adjustments. In one instance, where the spindle had been running loose in the taper bearing, this attempt was made, with the result that the taper bearing ran free in the bushing and the cutter floated on the work. Also, under these conditions, it usually is found that the machine has been slowed down so that not only inferior but also less work is produced. Efficient service with cutters that operate at high speeds will not permit makeshift adjustments of this kind. These conditions should be corrected by making permanent change-overs or repairs.

Thrust Collars may Cause Trouble

If the spindle mounting has a thrust collar at *E*, its sides should be parallel and it should be a good fit between the end of the taper bushing and the shoulder on the arbor. If there is a space between them, as shown in the diagram, all the end thrust will be directed against the taper bearing— and not against the thrust collar. This is often the cause of a milling cutter dragging at the back after the forward half of the cutter has passed over the work. If allowed to run for a considerable time, the bearing becomes hot and wears away on one side, leaving the spindle loose in the bearing. This condition will shorten the life between grindings, even if it does not continue long enough to wear the taper bearing seriously. It may even be necessary to replace the taper bearing with a new one and to regrind the spindle if it has worn out of round.

When the design of the spindle is of the type shown at *F*, with a thrust collar *G* between the spindle head and the end of the taper bushing, trouble from a loose fit in the taper bearing often occurs, due to this collar being too thick. This leaves the spindle supported only by the upper straight bearing, so that side movement of the cutter, due to the cutting pressure, will cause the spindle to spring. Then, after the advancing half of the cutter has passed over the work, the stress is gradually diminished so that the cutter will advance slightly to its normal position and take an additional cut or at least drag on the surface. The result

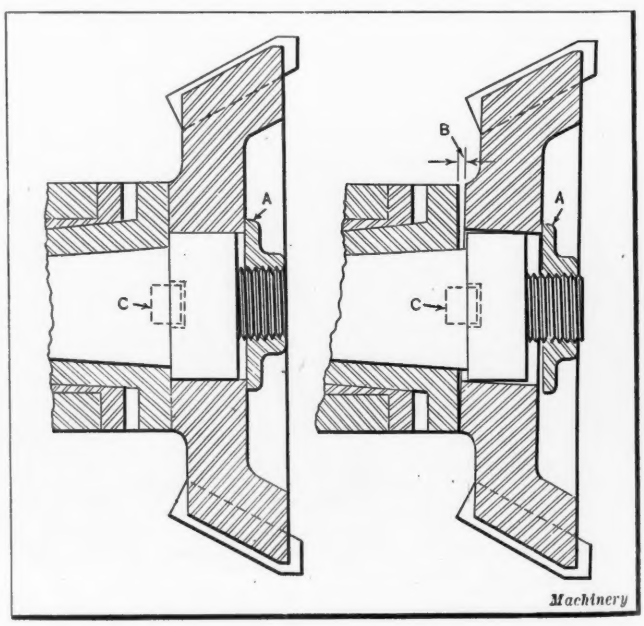


Fig. 3. Correct and Incorrect Cutter Mountings

is shortened life between cutter grindings and an inferior surface. This condition may cause the spindle to spring out of true to such an extent that it cannot be adjusted correctly in its bearing. When this occurs, the bearings and the face of the spindle should be reground, and the bushings replaced. If the cutter is free to move vertically and is adjusted to float on the work when taking a finishing cut, it may perform satisfactorily for awhile, but soon poor work will result.

A worn spindle mounting may have a greater or a less effect on the quality of work, depending on the design of the machine. When the drive is close to the end of the spindle, it is obvious that there will be the least cutter deflection.

Mounting the Cutter on the Arbor

The diagram at the left in Fig. 3 shows the proper mounting of the cutter on the arbor and its correct relation to the spindle. The nut *A* must seat evenly on the cutter body, and have a good thread fit on the arbor; otherwise the cutter is likely to become loose on the arbor, causing chatter, rough finish, breaking and crumbling of blades, or breaking of the edges and corners of the work. The back face of the cutter must be held squarely against the end of the spindle. The nut may locate the cutter properly against the end of the spindle, but in so doing it may draw out the arbor, leaving it loose in the taper hole in the spindle. This condition is of course objectionable, and the results are the same as those where the spindle is a loose fit in its taper bushing.

A slight space between the nut and the cutter or between the cutter and the spindle will cause the face of the cutter to run out of true, as shown by the exaggerated view at the right, and the amount multiples as the diameter of the cutter increases. With a 12-inch diameter cutter, a space of 0.002 inch at *B* will cause the face of the cutter to run out 0.004 inch. The arbor hole in the cutter must be kept free from burrs and chips; so must also the large diameter of the arbor, because this fit does not hold the cutter to the spindle, but merely locates it centrally with the spindle. The face of the spindle must be depended upon entirely to locate the cutter true with the spindle. The end of the spindle should be indicated, and be absolutely true before the cutter is put in place, and then the surface against which the nut bears should be indicated and should also be true.

The driving key *C* should have clearance in the driving slot of the cutter. If the key is a close fit in the slot and slightly out of square, it will bind and prevent the cutter from seating properly against the end of the spindle. Obviously the key must not bear in the bottom of the slot.

Changes Necessary to Correct Unsatisfactory Conditions

In one instance, on a planer-type machine, milling cylinder blocks 30 inches long with a table travel of 18 inches per minute and a depth of cut of ¼ inch, a production of 330 castings per grind was obtained with two of the cutters. The third cutter failed after 125 pieces. It was found that the condition of the machine was responsible for the failure of the third cutter, because the cutter was not presented to the work at the proper angle; the side spindle to which it was attached was found to be so much out of position relative to the table that the vertical driving shaft was binding in its bearings and the cutter could not be raised to the proper position. Incidentally, the driving spindle was running hot in the bearing. It was a simple matter to correct this condition by bringing the spindle head to the proper angle with the table. After this was done, the trouble disappeared, and each of the three cutters had an equal life between grinds.

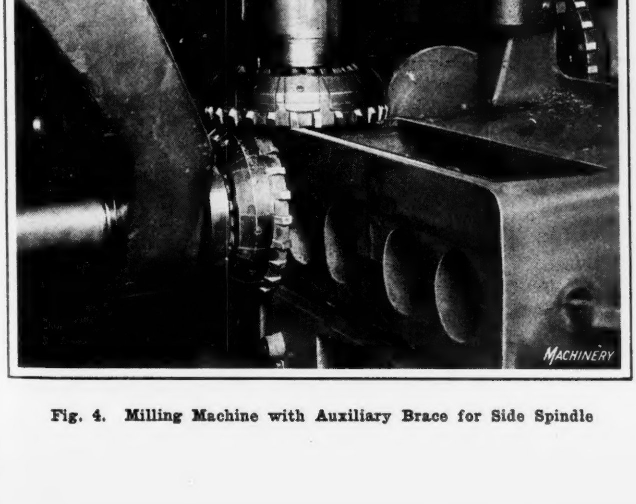


Fig. 4. Milling Machine with Auxiliary Brace for Side Spindle

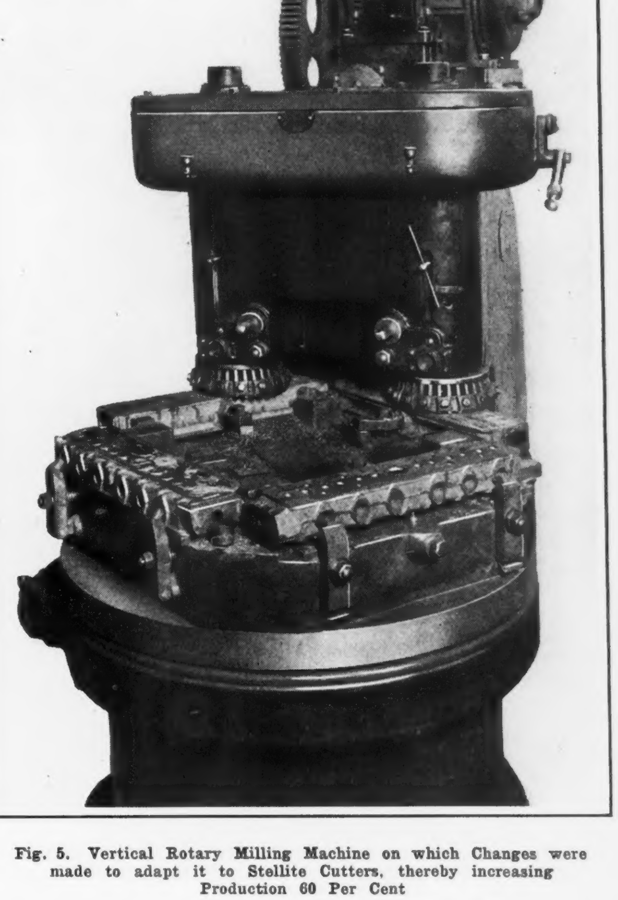


Fig. 5. Vertical Rotary Milling Machine on which Changes were made to adapt it to Stellite Cutters, thereby increasing Production 60 Per Cent

Vibration of the cutter and lack of rigidity of the work prevent rapid, accurate production with any milling cutter. In the case of worn spindle bearings, the unsatisfactory conditions may be intensified by an overhanging cutter, but it is usually possible to provide a brace or arm, as was done on the machine shown in Fig. 4, and thus eliminate vibration. The arm furnishes a bearing close to the cutter and gives the spindle the rigidity that a cutter of large diameter needs. This is a straight-line type machine with the arm used to support the side-head spindle. Another instance where the machine was changed from the usual practice is shown in Fig. 1. This machine was equipped with gears to obtain such a speed that 1280 blades were passed over the work per minute.

Fig. 5 shows a rotary milling machine, equipped with two inserted-tooth stellite milling cutters, on which changes were made to speed up production and enable all-around satisfactory results to be obtained. The operation is that of milling the bosses on a cylinder head casting. The areas milled are indicated by the sectioned portions in Fig. 6. It was found that the backs of the cutters were low, and

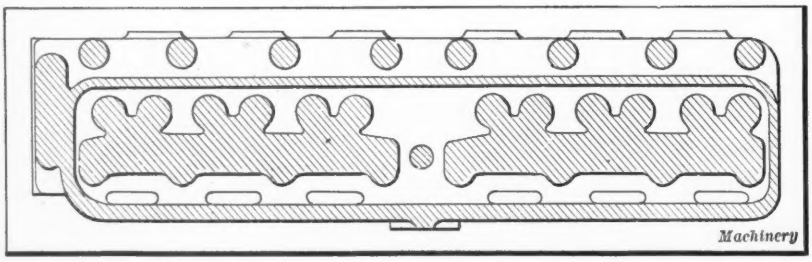


Fig. 6. Diagram of Cylinder-head Casting showing, in Section, the Areas milled on the Machine shown in Fig. 5

that it would be necessary to shift the housing to allow clearance. The speed of the machine was doubled by using a larger pinion on the motor.

On account of the inability to raise the cutter sufficiently, the bosses had been milled off to such a depth that the cutter blades were scraping on the scale of the casting in the recesses around the bosses. This, of course, decreases the life of a blade, and this condition was remedied by changing the locating points of the fixture so that they would bear between the bosses on the under side, instead of against the bosses.

These changes resulted in an increase in peripheral speed for the roughing cut from 55 to 110 feet per minute, and on the finishing cut, from 68 to 136 feet per minute. An increase in the life of the cutters also resulted, 200 cylinder heads being milled per grind instead of 44. The increase in production was 60 per cent, and the finish produced was smooth and clean.

* * *

MULTIPLE-JAW MILLING VISE

By J. T. LONGDON

The vise shown herewith was designed by the writer to hold six studs of the type shown by the dot-and-dash lines at *A*. The operation to be performed was milling the flats on the stud heads. Referring to Figs. 1 and 2, *B* is the cast-iron base of the vise. The jaws, one of which is shown at *C*, are T-shaped, and are made a snug sliding fit in a slot in the base. The jaws are held in position by plates *D*. They are a sliding fit on surface *E*, Fig. 2, and have a clearance on surface *F*. All the jaws are tightened simultaneously by a movement of lever *G*, the pivoted end of which is provided with a cam, which engages the end surface of jaw *H*, Fig. 1.

The end plate *J* acts as a stop which takes the thrust or clamping force exerted by the cam. The jaws are bored out to receive springs *K*. These springs expand the jaws when they are released by moving lever *G*. The position of the cam at the end of lever *G* can be adjusted in relation to the jaws. The adjustable feature was obtained by providing the head of stud *L* with a tongue *M*, as shown in Fig. 2, which fits into a slot milled in the boss on the under side of base *B*. This tongue positions stud *L* centrally, and also prevents it from rotating when the clamping lever *G* is actuated.

The stem of stud *L* passes through an elongated hole in the base of the vise, and then through the packing collar seen at *N* and the spacing bushing *O*, which serves as a bearing for the cam end of lever *G*. After the best working position of the cam has been found, the nut *P* is tightened, thereby clamping stud *L* firmly in position, and leaving the cam free to revolve on bushing *O*. A flat is milled on the back of the cam portion of lever *G* to permit the jaws to be opened wide when the cam is fully released. This enables the vise to be quickly loaded and unloaded. The shields *Q* prevent an excessive amount of chips from finding their way down into the chip space in the base of the fixture. By equipping a vise of the kind described in the foregoing with special jaws, it can be adapted for handling many different classes of milling and grinding work.

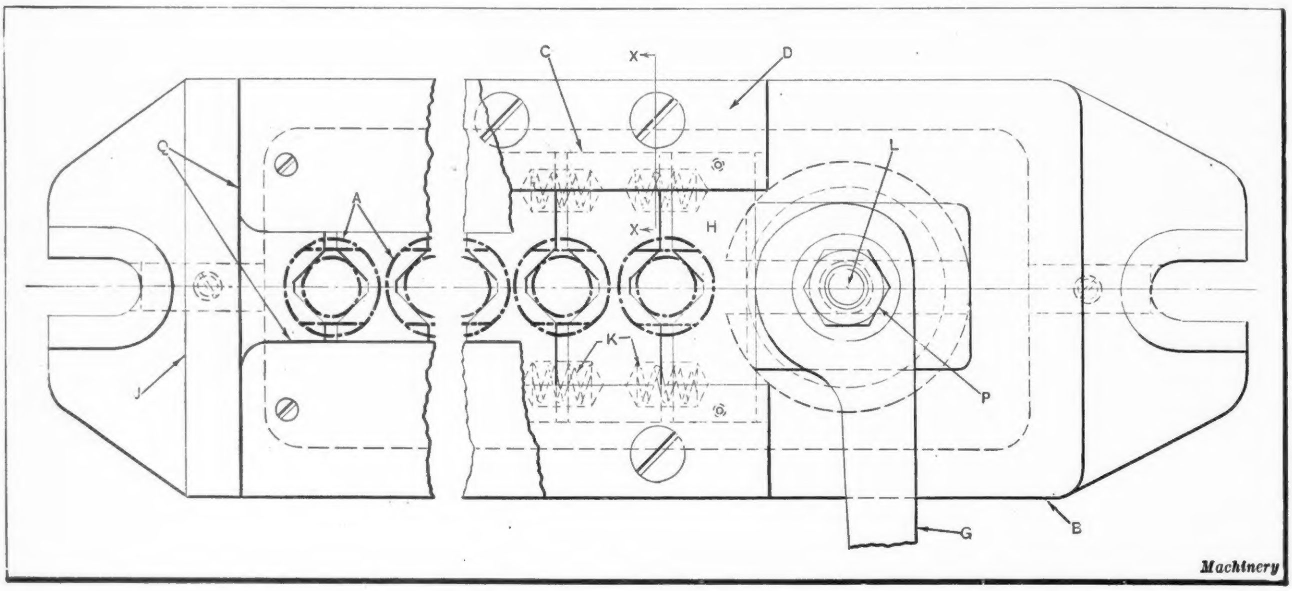


Fig. 1. Plan View of Multiple-jaw Milling Vise

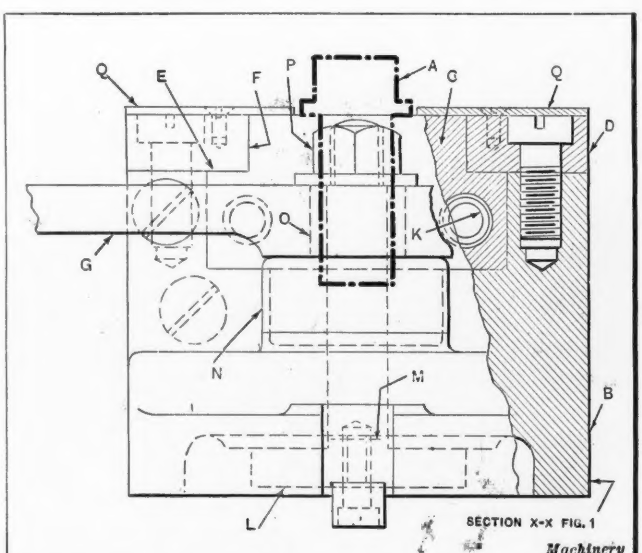
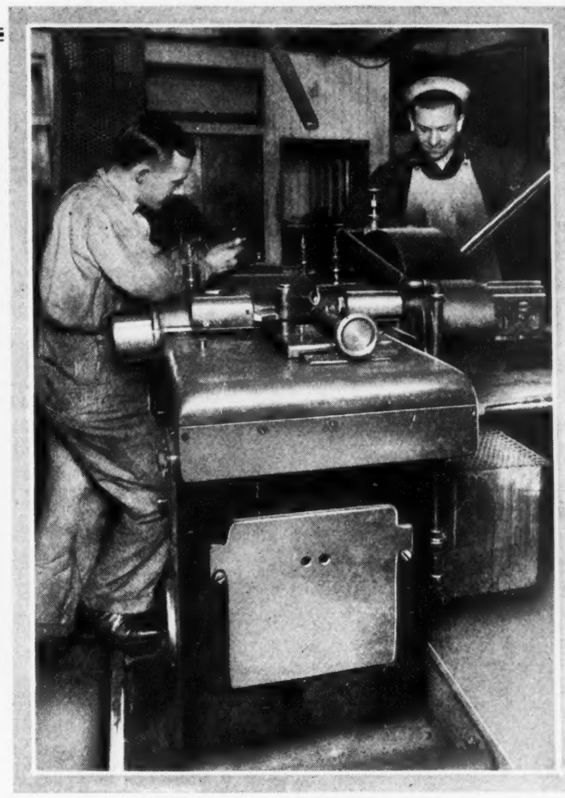


Fig. 2. End View of Vise shown in Fig 1

Centerless Grinding Methods



CENTERLESS grinding, as the name implies, is the grinding of cylindrical work without supporting it on centers in the usual way. In the Heim centerless grinding machine, on which the operations described in this article are performed, this is accomplished by employing two abrasive wheels. One of these wheels rotates in contact with the work at a very slow speed and serves only to rotate the work and advance it through the machine; the other wheel, located directly opposite it as shown in Fig. 2, does the grinding. It is possible to handle any plain cylindrical work without shoulders or tapers, but the best results are obtained on short cylindrical parts, such as rollers for roller bearings, wrist-pins, short shafts, and similar work of comparatively short lengths.

Before describing some of the details regarding the work of the centerless grinder, the design of this class of machine, in so far as it departs from older principles of grinding will be briefly described. In Fig. 1, which is a view from the driving side of a Heim centerless grinder, built by the Ball & Roller Bearing Co., Danbury, Conn., it will be seen that the end of one of the two wheel shafts is considerably lower than the other shaft. This shaft *A* supports the feed or regulating wheel at the opposite side of the machine, and it is inclined downward at a slight angle. This provides for spinning the work to advance it along between the wheels.

The work is loaded in a suitable support *B*, extending outward from the wheels, as illustrated in Fig. 2, and this support passes through the machine to the driving side. Each wheel is provided with a diamond dresser, which may be independently adjusted by means of a handwheel *C*, Fig. 1, as the diameters of the wheels are decreased through constant wear and truing. In dressing the regulating wheel, which, on account of not doing the cutting, wears slowly and consequently requires little truing, the handwheel shown at the front of the machine in Fig. 5 is operated to release a friction clutch, thereby increasing the speed of the regulating wheel during the dressing operation. A graduated collar facilitates the setting of the wheel-truing device, and a lever arm or handwheel is used to pass the diamond over the face of the wheel by turning the gear segment *D*, Fig. 1, which engages a rack for this purpose.

The normal operating speed of the grinding wheel is 1100 revolutions per minute, and this speed is constant, while the maximum speed employed for the regulating wheel is only 28 revolutions per minute. The regulating wheel is driven from a cone pulley within the frame of the machine, so that three speeds are available, although for the majority of the work the maximum speed is employed. The wheel speeds are calculated to give standard grinding speeds, and the changing of the regulating wheel speed is all that is necessary to give the correct grinding speed for work of different diameters and for roughing or finishing cuts.

If the work is not too long, it is usually fed into the support through a chute, as shown in the heading illustration, and for this class of work it is desirable to employ two operators, owing to the rapidity with which these parts are passed between the revolving wheels. A compound hand-

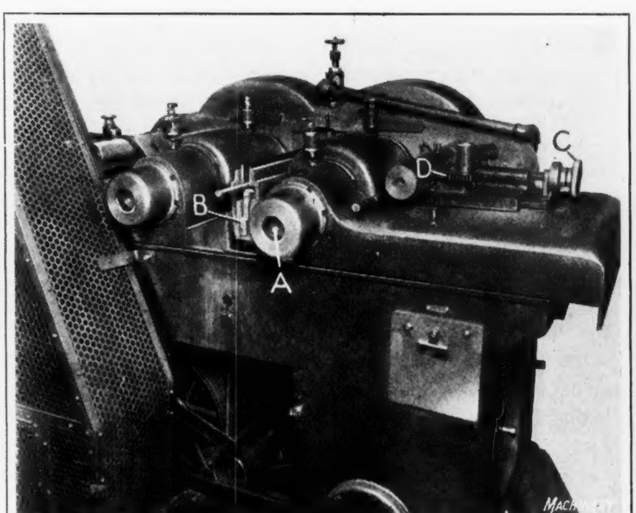


Fig. 1. Driving Side of Centerless Grinder, showing Grinding Wheel and Regulating Wheel Shafts and Wheel-truing Device

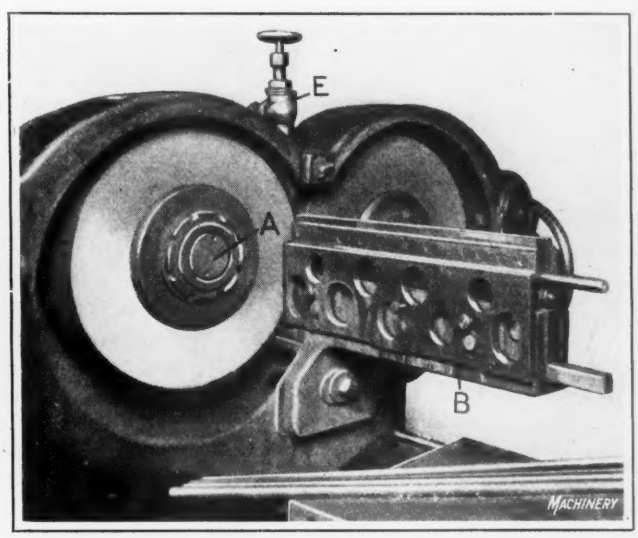


Fig. 2. Operating Side of Machine, with Grinding and Regulating Wheels exposed—also showing Fixture for grinding Rods

wheel at the end of the machine, which may be seen by referring to Fig. 5, is used to adjust the positions of the regulating and grinding wheels relative to the work, by moving the slides on which the wheel-heads are mounted. During the operation of the machine a stream of coolant is directed down between the two wheels (see valve *E*, Fig. 2) directly on the revolving work. The work revolves clockwise, as indicated by the arrows in Fig. 3, so that the grinding grit passes down and is washed away.

Types of Work-supports

In order to describe the work-supports used, it is necessary first to broadly classify the work. Short cylindrical parts up to and including, say, 5 inches in length and 1½ inches in diameter can be conveniently handled by feeding them through a chute into a support of the type shown in Fig. 4; the longer shafts up to possibly 3 feet in length must be passed through horizontally by hand. This is illustrated in Fig. 2, where the support for handling long work is shown attached to the machine.

In general appearance, the work-supports are very similar. An inspection of Fig. 3 will show the construction and adjustments incorporated in the fixtures for work of both classes. The two side members of these fixtures may be adjusted by means of the knurled screws shown on the sides, to give the proper opening for the diameter of work for which they are to be used. These side members have steel faces at the top on the inside, against which the work bears as it is fed through the machine.

The position of the work is indicated in broken outline as it rests between the steel faces, supported from beneath; also the relative position of the grinding and regulating wheels, as well as the directions of rotation, are shown. The under support may be either a roll or a stationary straight steel piece, depending on the work. If the work is long, the fixture contains at least three supporting sections. The middle section is located directly beneath the wheels and carries a steel strip *A* instead of rolls. These steel strips project slightly above their vertical support, and in the case of small-diameter work, the strip may be quite narrow at the top and slightly concave. The two end sections of the fixture carry rolls, the top surfaces of which are 0.003 inch above the strip *A*. The vertical supports for the rolls and for strip *A* are adjustable for height by means of a wedge member *B*.

In the case of short cylindrical work, the fixture has no rolls, and is made similar to the central portion of the fixture for rods, but in this case the steel strip has an angular face inclining toward the regulating wheel and extending above the support about 0.005 inch. The vertical support itself is not made of sections, like the rod fixture, but the strip mentioned is composed of small casehardened steel sections. This construction is a decided advantage, because when wear occurs, the worn sections can be replaced without disturbing the remainder of the support. The same wedge arrangement shown in Fig. 3 is used for raising or lowering the vertical support. Either type of fixture may be quickly attached to the side of the machine and adjusted to the diameter of work to be ground.

Setting up the Machine

In setting up the grinder, after the work-support has been attached, the necessary adjustments of the wedge are made to bring the work to the proper height. To do this, the bolts that clamp the vertical supports in position are loosened, and the wedge moved along. It will be noticed that the wedge *A*, Fig. 4, is graduated to facilitate this setting. Then the side members of the fixture are brought together sufficiently by means of knurled screws on the sides, to permit the work to be passed through without obstruction.

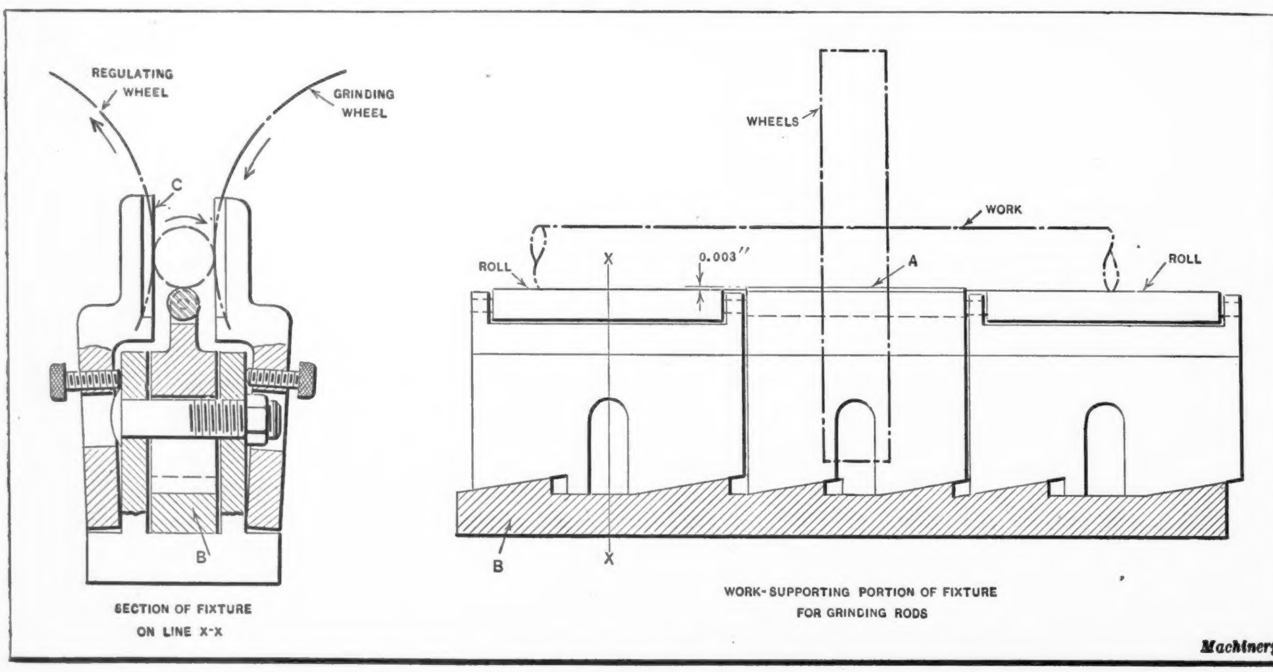


Fig. 3. Diagrams showing Construction of Work-holding Fixtures for Centerless Grinding and Relation of Work to Regulating and Grinding Wheels

The operator next adjusts the handwheel at the end, as shown in Fig. 5, to bring the grinding wheel against the work, which has been pushed through the fixture. The grinding wheel forces the work against the left-hand face *C*, Fig. 3, of the fixture, leaving a space between the work and the right-hand face of 0.003 inch in width. A feeler gage of this thickness is then passed between the work and the face of the fixture in the manner shown in Fig. 5. This is the allowance recommended so that the work will pass freely through the fixture.

It may be necessary sometimes not only to adjust the sides of the fixture, but also to move the vertical support sidewise slightly to bring it exactly central relative to the two wheels, but this is usually unnecessary after the fixture has once been set and clamped together. The work is next passed through by hand, and the regulating wheel brought into contact with it by turning the smaller of the two handwheels at the end. The machine is started and further adjustments made if necessary, to increase the contact

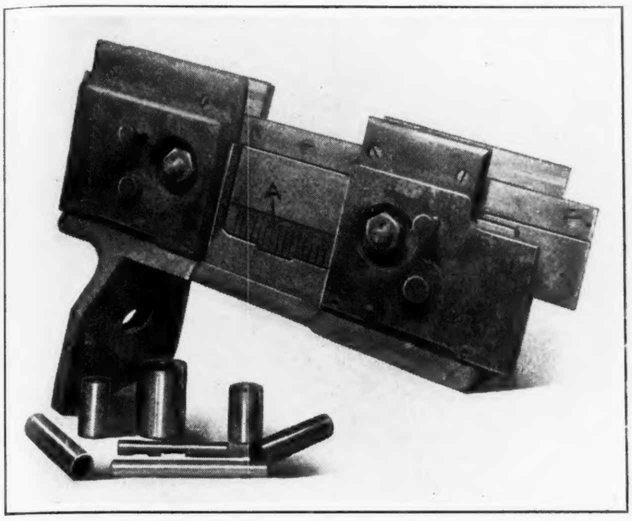


Fig. 4. Typical Cylindrical Work for the Centerless Grinder and Fixture used to guide Work of this Class

between the work and the regulating wheel enough to feed the work along.

When the regulating wheel has been set correctly, its face will extend in past face *C*, Fig. 3, about 0.003 inch. This amount, it will be remembered, is the same as that allowed for clearance between the work and the opposite face of the fixture in setting up. When the machine is set in this way, the work is ready to be ground and the operator need not make further adjustments until one cut has been taken on all the parts in a lot, at which time it is necessary to move the grinding wheel in for taking subsequent finishing cuts. Adjustment of the wheels is also necessary, of course, every time they are dressed.

Grinding Type-bed Rollers for Printing Presses

The Heim centerless grinders illustrated in this article are installed in the plant of the American Type Founders Co., Jersey City, manufacturer of Kelly printing presses. The rollers on which the type-bed of this press operates constitute a representative example of centerless grinding work. They are 1 inch in diameter, 1½ inches long, and must be ground uniformly and without taper to within a tolerance of 0.0002 inch on the diameter. There are thirty-six of these bed rollers on a machine, nine in a row, and they must be as near the exact size specified as possible so that the bed will not bear unevenly on them.

It is usual to allow about 0.006 inch on the diameter for grinding, and to employ three or possibly four cuts. In roughing, 0.004 inch is removed, and on the second cut 0.001 inch. The operator then examines his machine adjustments before taking the finishing cut. In cases where some of the parts do not come within the requirements, it is sometimes necessary to take a light fourth cut.

These rollers were formerly ground between centers at an average rate, for roughing and finishing, of 80 grinds per hour. When thus ground, centers had to be machined in the ends and a driving hole drilled, all of which is unnecessary with centerless grinding. Work of this size and type can be fed into a chute and passed through a centerless grinding machine at the rate of about 45 per minute, which is 2700 per hour for each pass, or a production of over 600 complete rollers an hour, allowing four passes per roller.

Finishing Rods by Centerless Grinding

The gripper rods used on Kelly printing presses represent an example of long work which must be fed through the machine horizontally by hand. These rods are about 0.50 per cent carbon steel and carry fingers for gripping the paper as it is passed over the press cylinder. The rods are shown in Fig. 2—one in the fixture and others on the shelf beneath it. They are ⅝ inch in diameter and about 25 inches long, and an absolute measurement of 0.625 inch on the diameter is the standard in grinding them. The same amount of stock, 0.006 inch, is left for finishing as on the rollers, and the same number of cuts is usually required.

A great deal more care must be exercised in performing the grinding operation on these rods than is necessary for the short rollers. In the first place, it has been found that irregularities on the work cannot be corrected by this method of grinding, and as a consequence the rods must be carefully straightened before each grinding operation, if a smaller tolerance than 0.002 inch is required.

There is another limitation that must be considered in grinding long work by the centerless method, and that is its weight. It has been found, when grinding heavy shafts, considerably more than an inch in diameter, that the weight is greater than the regulating wheel can drive without causing the work to lift. In fact, it would seem that this class of work is rather beyond the scope of centerless grinding, at least in its present stage of development, although there has been some heavy work ground on this style of grinder, 2 to 3½ inches in diameter and up to 39 inches long, using a fixture especially designed for this class of work. The production time for the gripper rods on a cylindrical grinder was forty-five minutes, as compared with from fifteen to eighteen minutes apiece by centerless grinding, for rods 25 inches long.

The speed and accuracy which can be obtained on rolls and similar work by centerless grinding constitute its chief advantage. The machines can be arranged for chute feed without difficulty, and a high production obtained. On the other hand, when long cylindrical parts are to be ground, it is necessary to take into consideration the extra work required between grinds in straightening, and the need of a helper, as well as a trained operator, for grinding this class of work. Although the production is high, even on rods and shafts, as compared with straight cylindrical grinding,

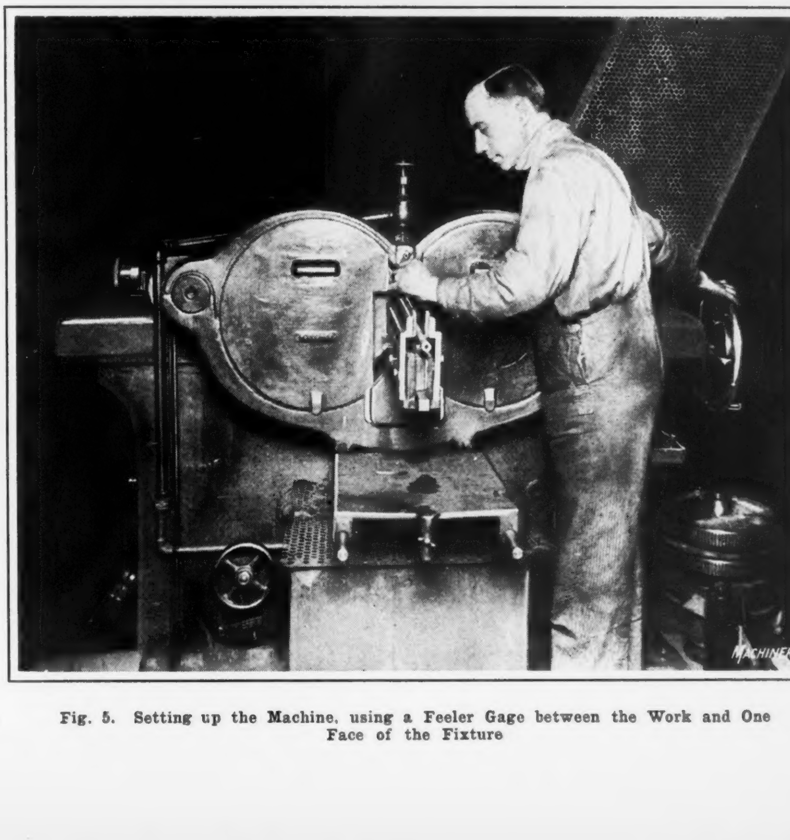


Fig. 5. Setting up the Machine, using a Feeler Gage between the Work and One Face of the Fixture

the additional cost of a helper, special fixtures, and straightening, detract somewhat from the advantage of greater production.

While it is customary in the plant referred to in this article to use a helper and an operator on all work, it is possible for one operator to attend to a machine alone, and under a favorable arrangement of machines to attend to two. The work of the helper is largely that of attending to the feeding while the operator, working from the opposite side, is gaging and clearing away the fast accumulating rollers and other parts fed to the machine from the chute, to prevent them from interfering with the flow of work and to safeguard them from injury in falling into a box or other receptacle.

* * *

ASSEMBLING GENEVA STOP-WHEEL MECHANISM

In order to insure the proper operation of a Geneva stop-wheel mechanism, such as shown in the view at the left-hand side of the illustration, it is necessary that the driving roller *A* be very accurately located on its arm. It is common practice for the draftsman to specify the distance between the centers of the arm hub *B* and the roller *A* in thousandths of an inch, and the shop man takes particular care to work closely to this dimension. When this method is employed, it is essential that an equal degree of accuracy be maintained in the center distance between the hub *B* of the arm and the shaft *C* on which the star wheel is mounted, since any error in this dimension would render useless the care taken in locating the roller on the arm. When jigs are not used, time can be saved by working to a nominal dimension for the center distance between hub *B* and wheel shaft *C*, and then locating the roller on its arm in the manner described in the following.

The stud hole in the arm is first located by scale measurement and bored 1/16 inch under size. A dummy stud, such as shown at *D*, having a shank 1/8 inch smaller than the finished stud, is then inserted in the arm *E*, an enlarged section of which is shown in the view at the right-hand side of the illustration. The roll *A* is placed in position on the dummy stud before the arm is assembled on its shaft. By turning the wheel and the arm, and adjusting the stud *D*, so that the roller is brought into exact alignment with the slot in the star wheel at its point of entrance, the position of the roller can be easily established.

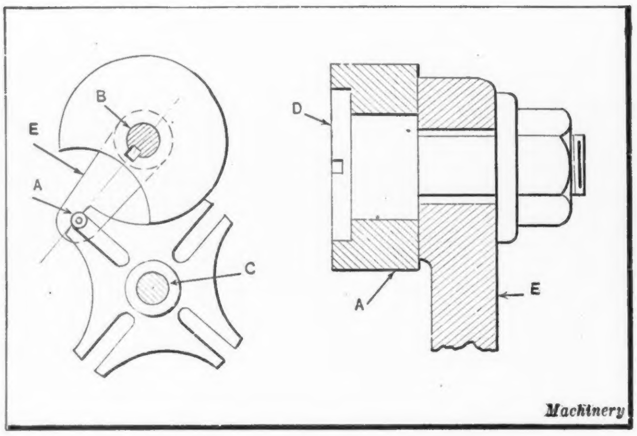


Diagram illustrating Use of Dummy Stud in assembling Geneva Wheels

The arm *E* is next removed from its shaft and set up in a lathe chuck, using an indicator for centering the roller *A*, which is clamped to the arm by the dummy stud *D*. The dummy stud is next removed, and the hole in the arm rebored to fit the shank of the finished stud. P. R. H.

* * *

PRICES OF MACHINE TOOLS AND COMMODITIES COMPARED

In order to show in a graphic manner the relation between machine tool prices and the prices of general commodities, the builder of a well-known line of machine tools prepared the three charts shown herewith. In these charts the full lines show the price fluctuations in general commodities, based on the wholesale prices as published by the United States Chamber of Commerce. These prices include the cost of clothing, farm products, house furnishings, etc. —briefly, the necessities of life. The dotted lines in each chart show the price of one specific line of machine tools built by this manufacturer. It will be seen that during the entire period of 1917, 1918, 1919, and 1920, when prices of other products mounted to such high levels, the prices of machine tools were far behind the cost of general merchandise. It will also be seen that at the end of 1922, the average prices of machine tools were slightly below the average price level, as far as the machines produced by this manufacturer were concerned, because one line of his product is ten points below the average, while the other two lines are only two points and four points above.

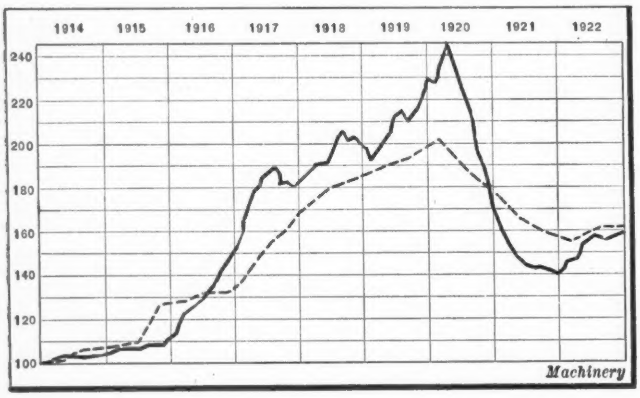


Fig. 1. Comparison between the Price of a Line of Machine Tools and the Price of General Commodities

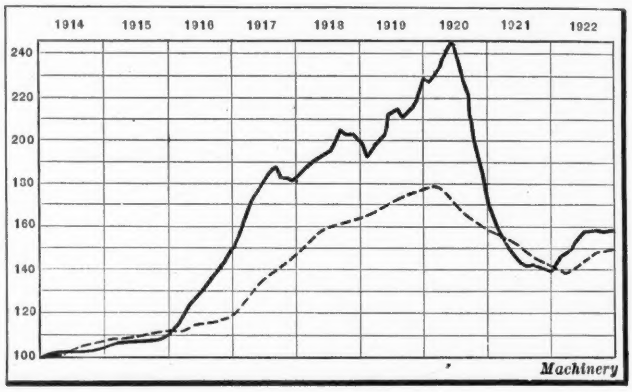


Fig. 2. Chart showing how a Line of Machine Tools increased 80 Per Cent in Price, as compared with 145 Per Cent for Commodities

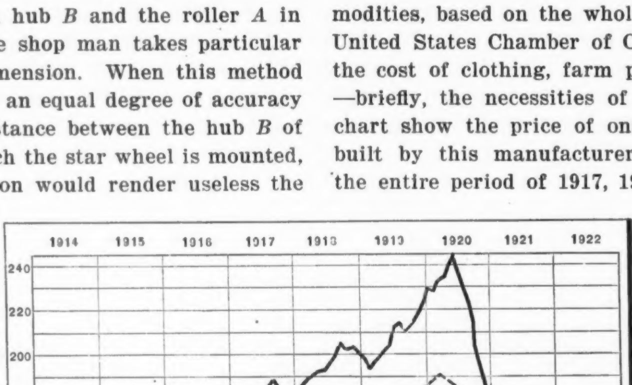
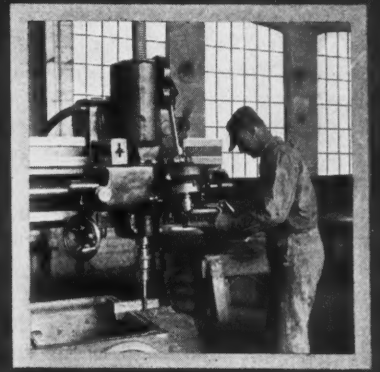


Fig. 3. Diagram showing how the Price of a Line of Machine Tools ran far behind the Average Level for Five Consecutive Years

Letters on Practical Subjects



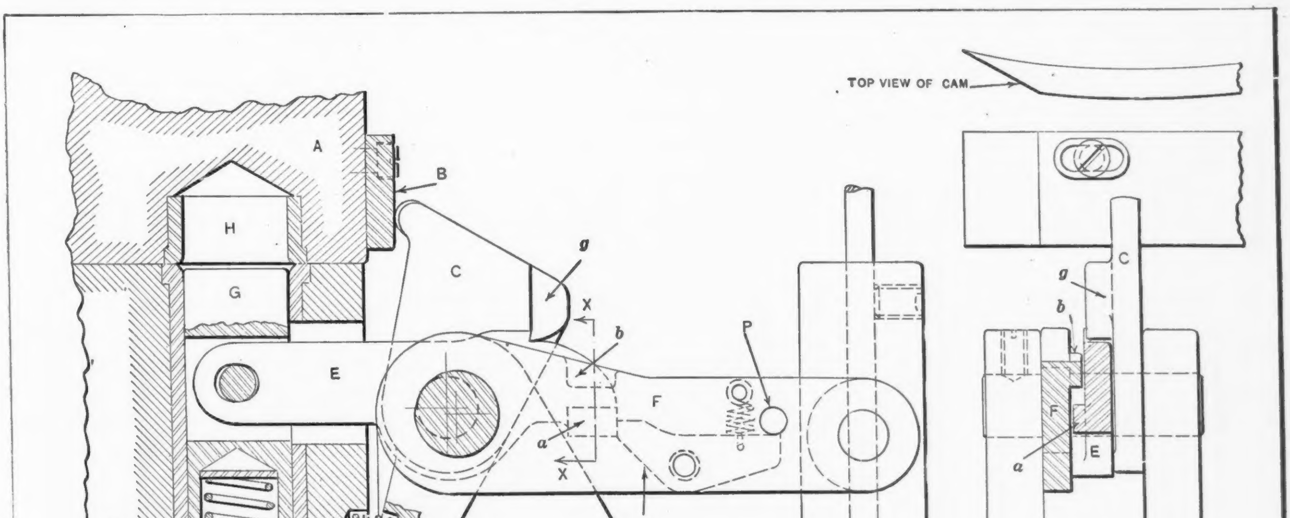
INDEXING MECHANISM FOR DIE-HOLDER

The mechanism shown in the accompanying illustration is designed to provide a safe and positive means of indexing the die-holder of a three-station upsetting die used on a large punch press. The die is hand-actuated and of the circular progressive type. In operation, the workman simply inserts the blanks (not shown in the illustration) in the rotating die-holder *A*, and trips the press. The die is then indexed one space, another blank inserted, and the press tripped again; thus the press can be kept in continuous operation. The ram is equipped with two punches. The first punch performs the work, and the second punch simply serves to push the completed part through the die, which is left open at the bottom to permit the parts to drop into a tote box. It will be evident from the preceding description that a piece is loaded into the locating die-holder, another piece upset and a third piece ejected, each time the press is tripped.

As the work is of irregular shape and is required to be held to very close limits, it is obviously necessary that the die-holder be indexed accurately and locked firmly in each position. If this is not done, the punch will not be properly aligned with the die, and either the punch or the die will be damaged or broken. Obviously it is also necessary to provide a safety device which will prevent the punch from being tripped at any time except when the die-holder is properly indexed and locked in place.

In the illustration, the safety device is shown in the position occupied when the die-plate *A* is being rotated to the succeeding station. It will be noted that the part *C* is held out or away from the die-holder *A* by the cam *B* which is attached to the die-holder. The nose of part *C* is spherical, and is kept in contact with cam *B* by means of spring *D*, so that the moment the end of cam *B* passes the spherical end of part *C*, the latter is forced in toward the die-holder, thus lifting the trigger portion *g* of part *C* out of engagement with the projecting corner of part *E*.

Part *E* has a projecting tongue *a* (see sectional view), which permits tongue *b* on part *F* to descend a limited distance. Now if part *C* is held away from the die-holder by cam *B*, the end *g* of part *C* will be held down, thus effectually locking part *E* so that its outer end cannot be moved downward. As the trip-rod *M* may be pulled down by means of a foot-pedal for about 1½ inches before actually tripping the press, it will be evident that as long as part *C* is held in the outward position by cam *B*, trip-rod *M* cannot descend far enough to trip the press, being prevented from so doing



Mechanism for indexing the Die-holder of a Three-station Upsetting Die

by contact of tongue *b* with tongue *a*. Cam *B'* can be adjusted to permit the spherical end of part *C* to travel inward toward the die-holder *A* at exactly the proper moment, or a fraction of a second before plug *G* is brought in position opposite hole *H*.

As the end of part *C* drops or rides off the end of cam *B*, spring *D* forces the end of part *C* toward the die-holder. This action lifts the latch *g*, thus permitting spring *K* to force plug *G* upward into the indexing hole *H*. The press is then tripped, and as lever *F* descends, the dog *L* will ride over the nose of part *E*. When lever *F* has moved down a certain distance, the nose of dog *L* snaps down under the tongue *a*, due to the fact that the fulcrum of levers *E* and *F* are at different points. The opposite end of dog *L* is prevented from rising by a pin *P*, when a spring (not shown) on the end of the trip-rod *M* returns the latter member to its first position. This movement elevates lever *F*, thus raising the nose of part *E* and compressing spring *K*, as well as withdrawing the indexing plug *G* from the hole *H*. At the same time the spherical end of part *C* rides up on the beveled end of cam *B* and pushes *g* downward, so that the entire mechanism is locked in the original position shown in the illustration.

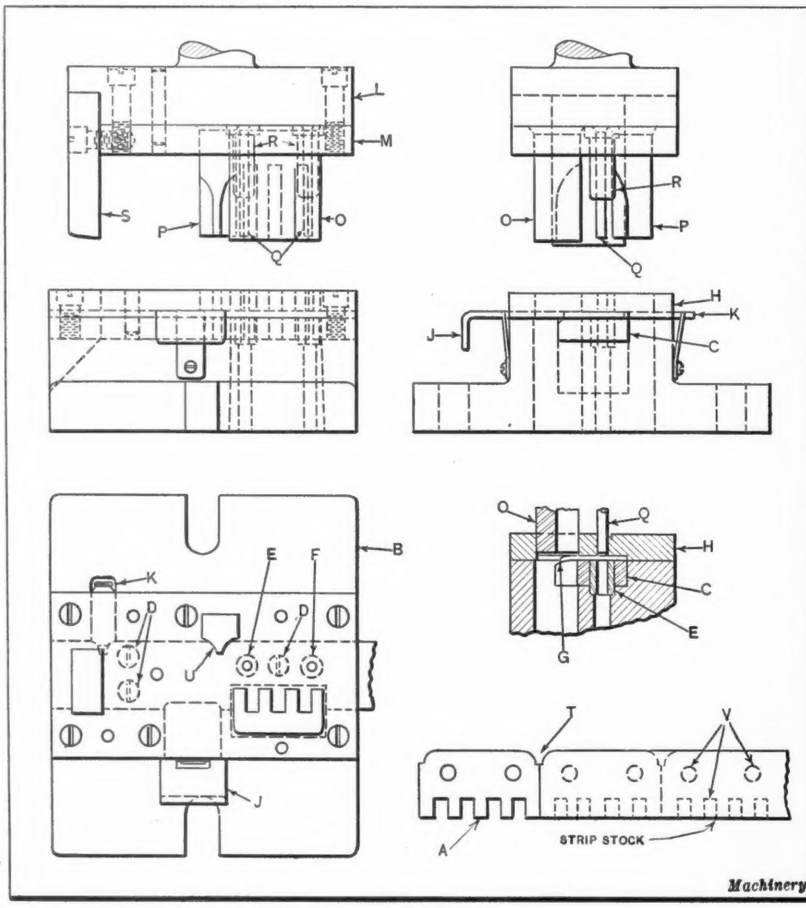
A little experimenting was necessary at first to determine the size of spring *K* which would maintain the proper balance with the trip-rod spring of the machine, but having solved this problem satisfactorily the mechanism gave excellent results.

W. R.

NOTCHING AND CUTTING-OFF DIE

When a worn out die is to be replaced, any weaknesses that have developed in use should be carefully considered and an effort made to eliminate them from the new die. The piece shown at *A* in the illustration was at first produced on a follow-die designed to pierce and blank the piece from the strip stock. The strip stock in this case was a little wider than the work. The whole die was composed of one block of steel and was rather expensive to make. The new die was designed to cut the pieces from strip stock the same width as the finished piece. This reduced the amount of scrap or waste, and eliminated one of the objectionable features of the follow-die. The construction of the new die will be understood from the following:

Referring to the illustration, the die-shoe *B* is grooved or slotted to receive the die *C*. This die is held in place by means of the three screws *D* and the two dies *E* and *F*, which are of the bushing type. The dies *E* and *F* are set into the die-shoe, and thus serve as dowel-pins as well as dies. The notched openings in die *C* were made with a milling cutter, and the necessary clearances filed by hand. The die after being hardened was rounded off at *G* by grinding, to give the teeth produced on the part a slight curl that is completed in another operation.



Die for notching, piercing and cutting off Piece shown at A

The strip stock is a loose fit in the slot milled in the stripper plate *H*, and the thrust imposed on the notching and shearing cutters is taken up by the stripper plate. The spring stops *J* and *K* are set in slots in the stripper plate. The machine-steel punch-holder *L* is provided with a punch-plate *M* in which the punches *O* and *P* are held. To prevent the punches from pulling out of plate *M*, the ends are headed over in the usual manner. The piercing punches *Q* are made of drill rod and are fitted and riveted into punch-holders *R*, which also have shoulders that prevent them from being pulled out of plate *M*. A shear blade *S*, attached to the end of the punch-holder as shown, cuts off the pierced and notched pieces.

In operation, the stock, which comes in 10-foot lengths, is fed into the die by hand until it comes up against the stop *J*. The press is then tripped, and on the down stroke of the ram, the two punches seen at *Q* pierce two holes, and the punch *O* notches the side of the stock. On the same stroke, punch *P* entering die opening *U*, notches or rounds the end of the stock. Upon the completion of the first stroke, the operator pulls back stop *J*, so that the stock can be fed up to stop *K*. The second set of notches and holes is then punched. Stop *J* now acts as a friction shoe, pressing the stock up against one side of the slot in the stripper.

Stop *J* is of the snap type, so that by pushing on the stock, the latter can be fed along to the third position, where stop *K* will snap into notch *T* previously produced by punch *P*. Here the third set of notches and holes is punched in the stock, as indicated by the dotted lines *V* in the view at the lower right-hand corner of the illustration, and the first complete piece *A* is sheared off. After the stock is started in the die, the press is run continuously at a speed of 90 revolutions per minute. The scrap or punchings cut out by punches *O*, *P*, and *Q*, pass down through the die to a scrap box, while the sheared off pieces slide down the chute at the back of the press.

Brooklyn, N. Y. S. A. McDonald

ADJUSTABLE HOLLOW-MILL

Several adjustable hollow-mills of the design shown in Fig. 1 have been in use for the last four years in the shop where the writer is employed. These tools are used for turning work up to ¾ inch in diameter. By making the tool with a tapered shank in place of the straight shank

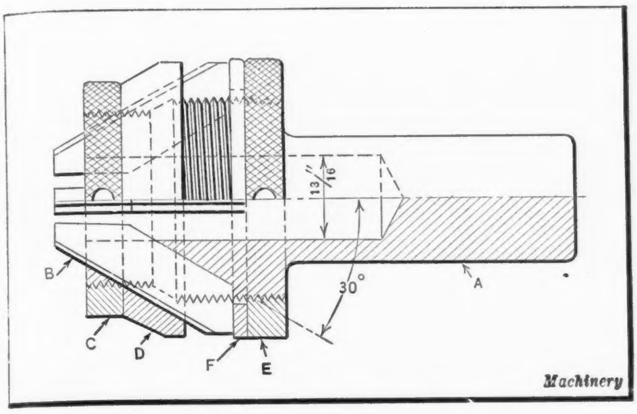


Fig. 1. Half-sectional View of Hollow-mill

shown, the hollow-mill can be used in a drill press. It is suitable for turning steel, brass, or gray iron parts.

The body *A* is made of soft steel. It has four 1/8-inch slots milled in the head end, which receive the blades, one of which is shown at *B*. The blades are made of high-speed steel, and are hardened and ground. They are rounded on one side where they bear against the collar *D*. Lock-nut *C*, when tightened against collar *D*, locks the blades *B* in position. The adjusting nut *E* which bears against washer *F* is employed in setting the blades for turning the work to the desired size. As all four blades rest on washer *F*, they are adjusted simultaneously. A spanner wrench is used to adjust the nuts *C* and *E*. The collar *D*, as well as nuts *C* and *E*, are made of soft steel, and are pack-hardened and ground. The washer *F* is also carefully hardened and ground.

A piece of screw machine stock, turned down to the exact size required, is used as a gage in setting the cutters. When nut *E* has been adjusted until all four blades are in contact with the piece of stock used as a gage, the spanner wrench is employed to tighten lock-nut *C*. The tool is then ready

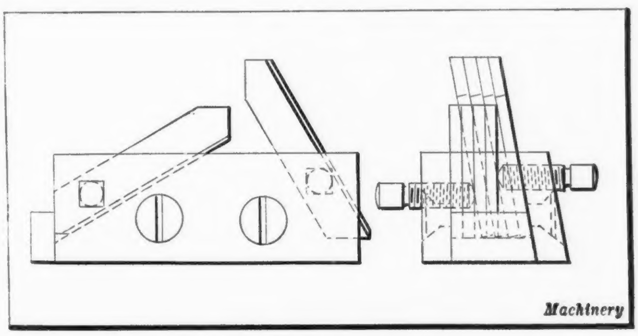


Fig. 2. Fixture used in sharpening Hollow-mill Blades on a Surface Grinder

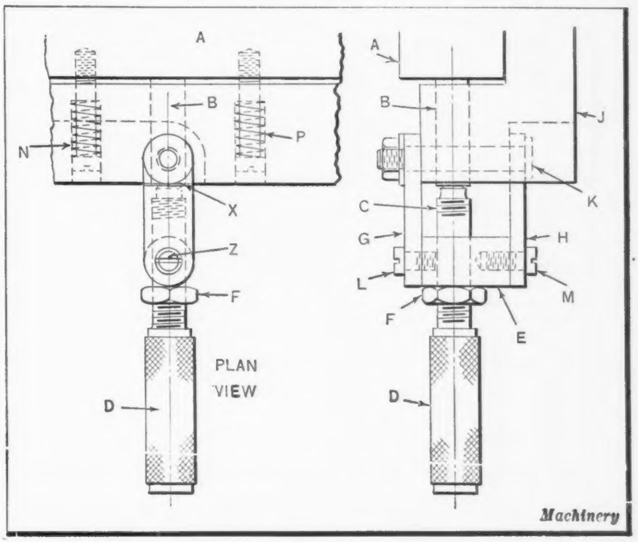
for a trial cut. The cutting edges of the blades are ground on a surface grinder by the use of the fixture shown in Fig. 2, which is held on a magnetic chuck.

Frankfort, Ind. ELSTO PARK

CLAMP FOR WORK-HOLDING FIXTURE

A powerful clamping device designed for use on work-holding fixtures is shown in the accompanying illustration. It can be operated with one hand and is particularly well adapted for use on drilling and milling fixtures, but may be used on almost any type of fixture. Referring to the illustration, *A* is a clamping block against which pin *B* operates when screw *C* is brought in contact with it by swinging handle *D* into the position shown. Screw *C* is mounted in a threaded block *E*. Nut *F* is tightened against block *E* in order to lock handle *D* securely in position after it is properly adjusted. Block *E* is supported by two links *G* and *H*, which, in turn, are held to the frame of the fixture *J* by means of a bolt *K*. It will be evident that the links *G* and *H* can be pivoted on stud *K*. The threaded block *E*, which is fastened to links *G* and *H* by screws *L* and *M*, is also free to pivot on these links.

Assuming that the handle lies against the side of the fixture at approximately right angles to the position shown in the plan view, the required clamping action is obtained by pulling handle *D* over to the position shown. In doing this, the end of the screw at *X* is brought in contact with pin *B*, so that center *Z* serves as a fulcrum point. This wedges pin *B* tightly against block *A*, which, in turn, clamps the work in place. Two springs *N* and *P*, in combination with screws, serve to pull block *A* away from the work when

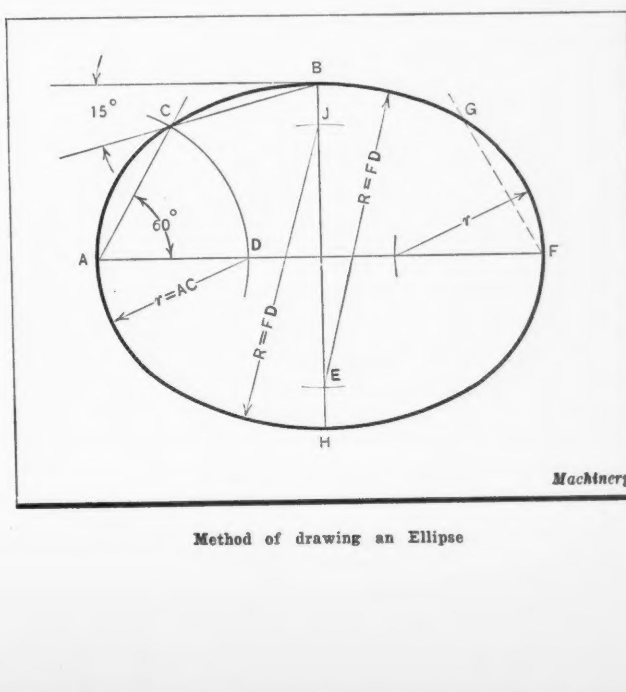


Clamping Device for Work-holding Fixtures

handle *D* is moved to release pin *B*. It will be observed that the frame *J* is cut out to allow the link *H* to swing around. Two of these clamping devices may be conveniently placed on the fixture so that the operator can grip one clamping handle in each hand. F. SERVER

DRAWING AN ELLIPSE

When instruments designed for drawing accurate ellipses are not available, the draftsman usually resorts to the well-known "concentric circle" method. In many instances, however, only a close approximation of the true ellipse is required. Various short-cut methods have been devised for use in such cases, but the writer believes that the one here



Method of drawing an Ellipse

described is more accurate and quicker than the majority of those in general use.

Referring to the accompanying illustration, let it be required to draw an ellipse having a major axis equal to *AF* and a minor axis equal to *BH*. From point *A* on the major axis, draw a line upward at an angle of 60 degrees, as indicated, and from point *B* on the minor axis draw a line downward at an angle of 15 degrees which will intersect the line drawn from *A* at point *C*. Now with *A* as a center and distance *AC* as a radius, draw an arc which cuts the major axis at *D*. Using point *D* as a center and taking *r* equal to *AC* as a radius, draw the half end of the ellipse which extends from point *A* to *C*. Repeat this operation for end *F*, where point *G* corresponds to point *C*.

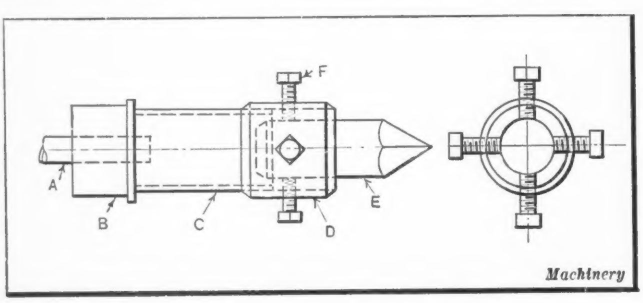
Next with *B* as a center, mark off distance $BE = FD$ on the minor axis. Now using *E* as a center and $R = FD$ as a radius, draw an arc which will connect points *G* and *C*. This completes the half side of the ellipse. The other side of the ellipse *AHF* is completed in the same manner. [For other methods of drawing an ellipse see page 258 of MACHINERY'S book "Mechanical Drawing"—EDITOR.]

Bridgeport, Conn. ARTHUR H. PONELEIT

GAS-HEATED SOLDERING IRON

The gas-heated soldering iron shown in the accompanying illustration has given excellent results in a large factory engaged in the manufacture of electric washing machines. A soldering iron of this type is economical as regards fuel consumption, because it serves as a pre-heater and soldering iron. It is well known that solder will not run freely unless applied to a heated surface. The necessary pre-heating can be readily done with a gas-heated soldering iron. The old method was to employ two soldering irons, one for pre-heating and the other for spreading or running the solder. This was rather inconvenient, however, as it necessitated frequent changing of irons.

With a gas-heated soldering iron of the type described, the necessity of changing soldering irons is eliminated; this not only means a saving of time, but also insures a uniformly soldered joint, as the joint, regardless of its length, can be soldered with one sweep of the iron. The expense involved in making a soldering iron of this type is very low,



Easily Constructed Gas-heated Soldering Iron

in comparison with the time and labor that it will save. The parts required to make up an outfit such as shown can be purchased at almost any hardware store.

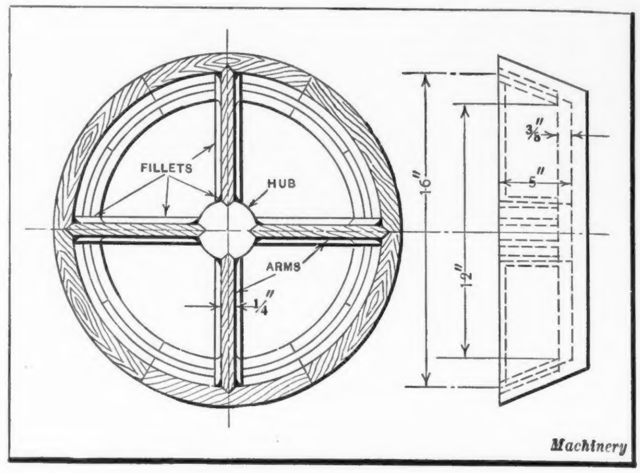
Part *A* is the end of a ⅜-inch gas blower or torch, which is provided with inlets for the gas and air pipes. Part *B* is a 1¼-inch iron pipe cap, part *C* a 1¼- by 3-inch iron pipe nipple, and part *D* a 1¼-inch pipe coupling. A piece of 1-inch round copper bar *E*, forged or machined to a point as shown, serves as the soldering iron. The shape of the point may be varied to meet requirements. Four ⅜- by ¾-inch set screws *F* are required to hold the bar *E* in place. About 20 feet of rubber hose to fit the torch connections is required, 10 feet being used for the gas line and 10 feet for the air line. Before assembling the parts, a hole is drilled in the pipe cap *B* to fit the torch *A*. After this is done, parts *A* and *B* are brazed together. The next step is to drill and tap four holes in coupling *D* to receive the ⅜-inch set-screws *F*.

After the torch has been assembled and connections made to the gas and air lines, the outfit is ready for use. In setting up, the best results can be obtained by running or dropping the pipes from overhead gas and air lines and providing an ordinary hook on which to hang the outfit when it is not in use. This hook should be located high enough above the floor to clear the workman's head.

Cicero, Ill. JOHN J. BORKENHAGEN

IMPROVING CORE-BOX CONSTRUCTION

Recently the writer's attention was directed by the foreman coremaker to a mistake in the construction of a core-box. The foreman explained why it was necessary to make alterations in the core-box before a core could be made.



Core-box made with Loose Arms

He also explained the use of "white sand" in the production of the core. The core-box, as originally constructed, is shown in the accompanying illustration. The hub was fastened to the bottom of the core-box, and the four arms were located by means of slots cut in the hub and the rim, but were left loose in the pattern. Evidently the patternmaker believed that this construction would permit the arms to be withdrawn easily from the core one at a time. However, he overlooked the fact that in fastening ⅜-inch wooden fillets to the rim and hub ends of the arms, it became impossible to withdraw the arms from the tamped-in core. Before the core could be made, the eight fillets at the rim ends of the arms had to be removed. The use of fillets in such a manner that they prevent the withdrawal of loose pieces is a mistake often made by the apprentice pattern-maker.

The rounding of the corners, for which the fillets were provided, was easily accomplished by the molder. It might be stated here that time is often wasted in putting in fillets on patterns and core-boxes, when only a few castings are needed, as the rounding of corners can be easily done by the molder. A better method of constructing the core-box would have been to make the hub and arms as one unit, and a loose fit in the box, so that the unit could be easily drawn from the molding sand.

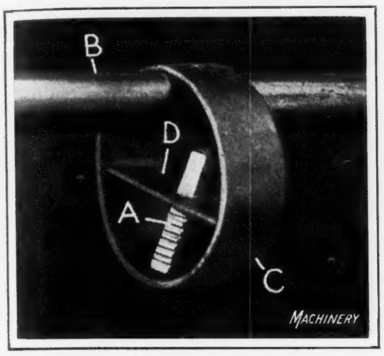
The core-box is so constructed that the sections of the core between the arms will be connected by a layer of molding sand, ⅜ inch thick. In order to prevent this thin section, as well as the sand forming the sides of the core slots from breaking or falling down when the core is rolled over on the core drying plate, the molder poured "white sand" (not molding sand) into the arm slots up to the top of the core. The "white sand" served to support the molding sand and was easily removed after the core had been properly baked.

Kenosha, Wis. M. E. DUGGAN

Shop and Drafting-room Kinks

BROACHING KINK

The little kink described in the following was employed to advantage in broaching small square holes in a lot of 7/8-inch shafts. The work consists of driving a short finishing broach *A* through the drilled hole in shaft *B* with a hammer. As the broach cuts for nearly its full length, it was necessary to use a punch when the top of the broach was flush with the work. The shafts were supported in V-blocks held in a vise.



Method of preventing Broach from falling

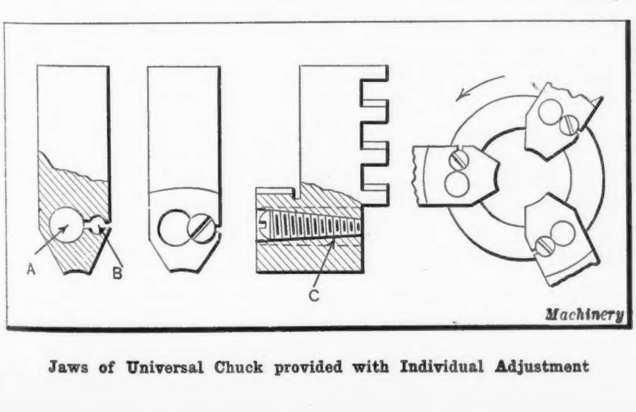
In order to prevent the broach from falling to the floor when driven through the work, a ring *C*, made from a short piece of tubing, and a piece of sheet metal *D* were arranged as shown. A hole was drilled in the ring *C* and the sheet-metal piece *D* so that when the broach was driven through the shaft it would fall into the hole in piece *D*, but would be prevented from falling to the floor by the lower part of the ring *C*. The sheet-metal piece *D* was secured to ring *C* by solder.

Rosemount, Montreal, Canada HARRY MOORE

ADJUSTING SCREWS FOR UNIVERSAL CHUCK JAWS

Trouble is sometimes experienced in making the jaws of a universal chuck center the work properly, due to wear of both the jaw and the scroll plate. Shimming with paper and thin steel is a very unsatisfactory method of eliminating the trouble. Paper shims are quickly cut through by the chuck jaws and steel shims of the right thickness are seldom available. The difficulty can be overcome, however, by the use of jaws equipped with tapered screws, as shown in the accompanying illustration. Arranged in this way, the jaws have a sufficient range of adjustment to permit the work to be properly trued up.

The process of equipping the jaws with adjusting screws consists of drilling two holes *A* and *B* in the front end of each jaw. Hole *A* provides the spring tension required to hold the adjusting screw in position, and hole *B* receives the tapered adjusting screw *C*. After the adjusting screw hole has been drilled and tapped, it is cut through as shown in the view at the extreme left-hand side of the illustration.



Jaws of Universal Chuck provided with Individual Adjustment

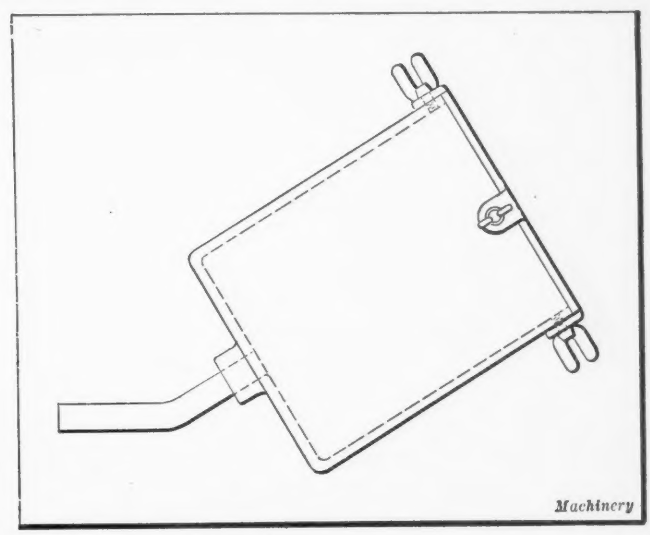
The adjusting screw should be taper-threaded on a lathe to the same taper as that of the tap. Care must be taken to have the adjusting screws located on the rear or driving sides of the jaws, as shown. After the jaws have been properly machined for the adjusting screws, they should be hardened. The adjustment required is only a few thousandths of an inch at the most, and this is readily obtainable by adjusting the screws in the three individual jaws.

Allentown, Pa. JOE V. ROMIG

TUMBLING BARREL FOR SMALL PARTS

In small jobbing shops, the use of a tumbling barrel would frequently effect a saving in the time required for polishing parts that are ordinarily buffed. However, in many cases, the number of such parts produced is not sufficiently great to warrant the purchase of a regular tumbling barrel.

A small tumbling barrel that has been used with success under such conditions is shown in the accompanying illustration.



Tumbling Barrel for Small Parts

It consists of a cast-iron body with a removable sheet-steel lid secured by thumb-screws. This barrel is mounted on a short cold-rolled steel shaft which is bent at an angle of about 30 degrees with the axis of the body. In use, the end of the shaft is held in an ordinary lathe chuck. The parts to be tumbled are placed in the body together with the polishing material, which may consist of steel balls, sawdust, scraps of leather, emery, or some other polishing agent, and the lid is clamped in position by the wing-nuts. By running the lathe at a slow speed, the parts may be given a fine polish. P. R. H.

SETTING SPIRIT LEVEL GLASS

A simple method of setting a spirit level glass is to use a small piece of putty to support each end temporarily. The plastic putty can be made to hold the glass in the required position, it being an easy matter to depress either end so that it will be parallel or level with the working surface of the leveling bar. When properly leveled up in this way plaster-of-paris is poured around the supporting ends of the glass and allowed to set. The glass will then be held permanently in place.

Rochester, N. Y. J. H. BEEBEE

Questions and Answers

ROYALTIES PAID BY MANUFACTURERS OF PATENTED ARTICLES

H. E. W.—What is the customary royalty paid by manufacturers for the privilege of manufacturing and marketing patented mechanical devices?

A.—The royalty may be either a certain percentage of the selling price or a certain fixed amount for each article manufactured, but the amount varies in almost every case because of the endless variety of conditions that affect royalties. According to a prominent patent attorney, it is not feasible to give general figures, and a royalty which is too high in one case may be entirely too low in another. For instance, when the manufacturer must invest in new equipment, and when the cost of selling a product is likely to be high, it is apparent that the manufacturer should have a larger royalty than would be required if the risk assumed were less. Because of these variable factors, 5 per cent royalty might be fair to both patentee and manufacturer under given conditions, and too low under other conditions. In other words, it is not feasible to establish the royalty by considering what someone else has done, but rather to establish it on a business basis, considering the facts covering the particular case under consideration.

PROBLEM IN GAGE DESIGN

B. A. H.—In designing the gage shown in Fig. 1, a mathematical problem is involved in determining the distance x, which gives the location of the line of intersection of the spherical and conical surfaces. How can distance x be found?

ANSWERED BY WILLIAM W. JOHNSON, CLEVELAND, OHIO

With the values given in Fig. 1 substituted in Fig. 2 for a, b, r, and $E + D$, the distance x can be found as follows:

$$\text{Tan } E = \frac{a}{b} = \frac{1}{32} \div \frac{7}{32} = \frac{1}{7} = 0.14285$$

and

$$E = 8 \text{ degrees } 7 \text{ minutes } 48 \text{ seconds}$$

Then

$$\text{Angle } D = 30 \text{ degrees} - E = 21 \text{ deg. } 52 \text{ min. } 12 \text{ sec.}$$

$$c = \sqrt{a^2 + b^2} = \sqrt{(1/32)^2 + (7/32)^2} = \frac{5\sqrt{2}}{32}$$

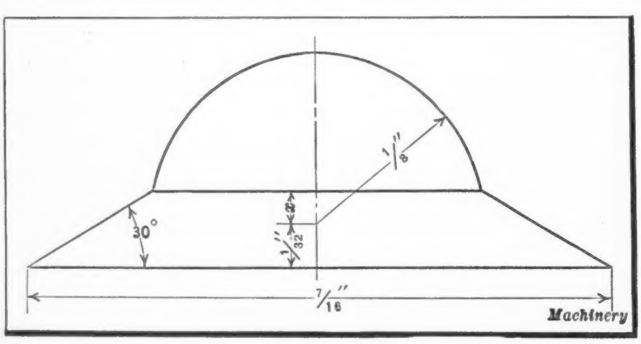


Fig. 1. Gage having Spherical Surface involving Mathematical Calculations

From the right triangle ACM, we find $AC = 2\,(a + x)$, since the side AC is twice the length of the side opposite the 30-degree angle.

In the oblique-angled triangle ACB, we have given two sides and the angle opposite the shorter side, to find the remaining side AC.

From trigonometry,

$$\text{Sin } X = \frac{c \sin D}{r} \text{ and } 2\,(a + x) = \frac{r \sin (X - D)}{\sin D}$$

Substituting the known values, we find

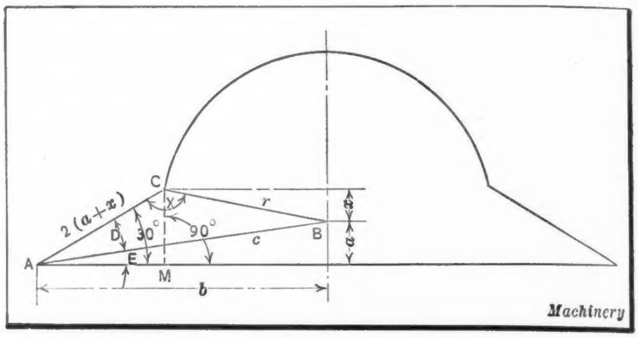


Fig. 2. Diagram used in the Solution of the Gage Problem

$$\text{Sin } X = \frac{5\sqrt{2} \sin 21 \text{ deg. } 52 \text{ min. } 12 \text{ sec.}}{4} = 0.65847$$

Then

$$X = 41 \text{ deg. } 11 \text{ min. } 7 \text{ sec. and } (X - D) = 19 \text{ deg. } 18 \text{ min. } 55 \text{ sec}$$

$$2\,(a + x) = \frac{\sin 19 \text{ deg. } 18 \text{ min. } 55 \text{ sec.}}{8 \times \sin 21 \text{ deg. } 52 \text{ min. } 12 \text{ sec.}} = 0.11099$$

and

$$x = \frac{0.11099 - 2a}{2} = 0.0555 - a$$

$$x = 0.0555 - 0.03125 = 0.0243 \text{ inch}$$

QUESTIONS RELATIVE TO TRADEMARKS

I. C. M. Corp.—What is the Government charge for filing an application for a trademark, and for what length of time is a trademark granted? Does a registration in the United States give any protection in foreign countries, or is it necessary to register the trademark in each country with which a concern does business and desires protection?

ANSWERED BY GLENN B. HARRIS, YONKERS, N. Y.

The government fee on filing each application for a trademark is $10, and the term for which a trademark is registered is twenty years, unless it has been previously registered in a foreign country. In such a case, the term expires with the foreign registration, provided the latter has a shorter period than twenty years to run. A trademark may be extended indefinitely for periods of twenty years each, upon making proper application and paying a fee of $10 for each renewal.

Registration in the United States affords no protection in foreign countries, but under a convention adopted for the establishment of an International Bureau at Havana to carry into effect regulations for the protection of trademarks, the Commissioner of Patents communicates to this bureau the trademark sought to be protected. The fee is $5 to the United States Government and $50 to the International Bureau. As this protection is almost universal, it would seem advisable for those employing trademarks in their commerce with foreign countries to take advantage of it. There is an unscrupulous class ever on the lookout to pirate trademarks, and when trademarks have been registered even though wrongfully, the rightful owner loses all rights or can only regain them at considerable expense.

LAYING OUT A PATTERN FOR A FIVE-PIECE ELBOW

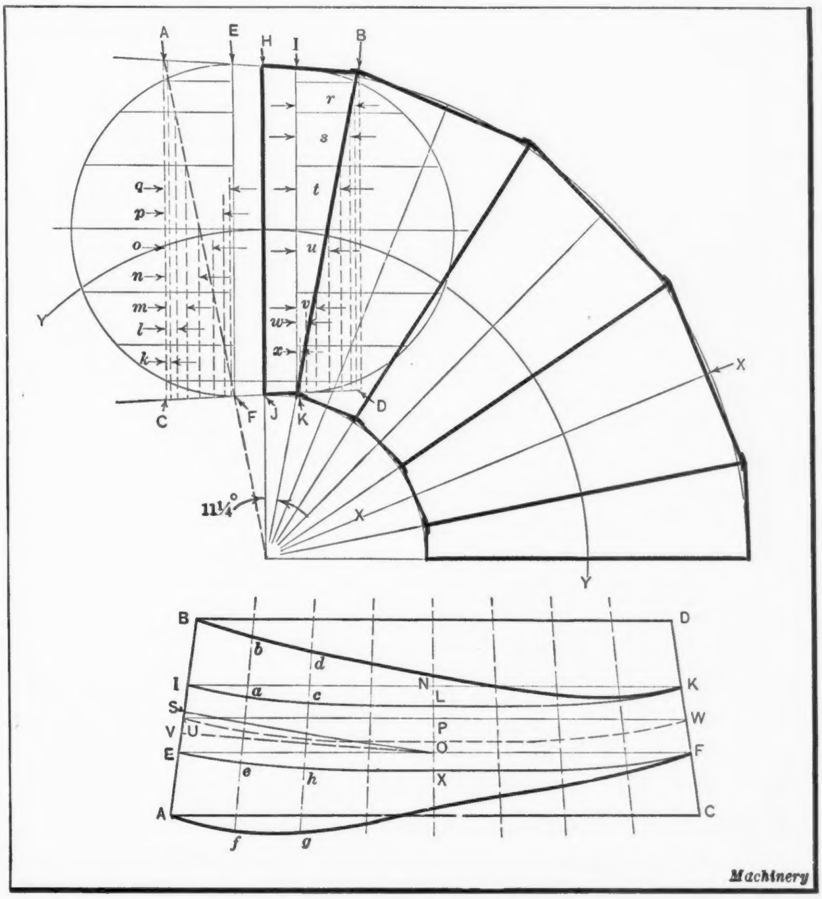
By F. WEBSTER

The procedure followed in laying out the pattern for a five-piece 90-degree sheet-metal elbow is described in the following: The diameter of the elbow is 54 inches and the metal used is 1/4 inch thick. With this type of elbow it is necessary that the sections be tapered so as to form slip joints. This necessitates the crimping or forming of the ends of the sections so as to conform with the angle at the joints. It will be evident that an elbow of this kind should be laid out in eight segments of 11 1/4 degrees each.

The first step in making the lay-out is to draw an arc *Y–Y* to represent the center line of the elbow. The cross-section outlines at the ends of the elbow and at the middle of the three large sections, as taken on line *X–X* for instance, are true circles, while those at the joints are elliptical. The taper of the sections should be such that, when taken with the diameter of 54 inches at the middle, the outside diameter of the small end will be equal to the inside diameter of the large end.

In order to lay out the pattern for the sections, it is necessary to use a number of construction lines. The construction lines are applied to the portion of a cone that is formed by the outlines of one of the sections, as shown in the accompanying illustration. The line *HJ* represents the diameter at the circular end of the elbow, and the line *IK* represents the diameter as measured at point *K* at the inside or small end of the joint. The line *EF* is a construction line drawn parallel to line *IK* from point *F*, and represents the diameter at the large end of the tapered section *EIKF*. The first step consists of developing the pattern for this section. The extensions that form the sections represented by *AEF* and *BIK* are then developed as additions to the pattern for the section *EIKF*.

In laying out the pattern for the latter section, first draw the line *IK* on the pattern plate, as shown in the lower view, making this line equal in length to one-half the circumference of the outside of the section at the small end. As the sides of this section are symmetrical, it is only necessary to lay out the pattern for one-half of the section. The length of the line *IK*, as shown in the lower view, is equal to (54 × 3.1416) ÷ 2, and the length of the line *EF* is equal to (54 1/2 × 3.1416) ÷ 2. These equations give the semicircumference at the small and large ends, respectively, of the section *IKFE*. The distance *NO* between the lines *IK* and *EF* is made equal to the distance between the lines of the section. The end lines *IE* and *KF* are next drawn in, after which the camber lines are developed.



Development of a Pattern for a Five-piece Elbow

In order to determine the amount of camber on the pattern for the conical surface, which has a very slight taper, a line *OS* is drawn perpendicular to the line *AB* from center *O*. The angle *SOE* is then bisected by line *OV*. The dimension *VE* represents the camber which is to be laid off on the center line, as indicated by *OX*. A curve is then drawn through the points *E*, *X*, and *F*, thus forming the edge of the pattern, which corresponds to a section on line *EF* of the upper view.

The lines *IK* and *EF* of the lower view are next divided into eight equal parts, as shown by the dotted radial lines. Points are then located on each of these radial lines at a distance from curve *EXF* equal to the dimension *IE*. Through these points is drawn the upper camber curve *ILK*. The resulting pattern *ILKFXE* is that required for the part of the elbow represented by the section *IKFE* in the upper view. In addition to this pattern, it is necessary to add the extensions represented by the triangles *AEF* and *BIK*, as shown in the upper view.

The next step in the construction is to draw semicircles on each end (*IK* and *EF*) of the taper section *IKFE*, in the upper view, as shown, and divide each of these semicircles into eight parts. Then draw horizontal lines through these eight division points at right angles to the vertical center line of the semicircles. Where these division lines cross lines representing the joints *BK* and *AF*, draw lines to meet the lines *CF* and *KD*. Finally, lay off on the pattern in the lower view, the extension *IBDK*, and the extension *EACF*. Next make distance *ab* equal to distance *r*, distance *cd* equal to *s*, etc. Likewise, make *ef* equal to *q*, *gh* equal to *p*, etc. Then draw the curves *BK* and *AF* in the pattern lay-out. The pattern for a complete half section is represented by the lay-out *ABKF* in the lower view. The pattern for an end section is represented by the part of the full section pattern enclosed by the lines *AUWF*. The amount required for lap at the joints must, of course, be added to the pattern lay-out thus obtained.

The pattern curves are usually shown to a very small scale in printed illustrations. Hence, they are considerably distorted from their true form at the working size.

* * *

Complete electrification of the Swiss Federal State Railways has been decided upon by the Swiss Government. Present plans call for the completion of this electrification by 1928. The cost will involve an expenditure of from 75,000,000 to 80,000,000 francs annually until the electrification is completed. Switzerland, being only about the size of Massachusetts, the total length of the railroads involved is but 1000 miles.

The Machine-building Industries

THERE has been no important change in conditions in the machine tool industry during the past month. As a whole, the industry is booking orders averaging from 40 to 50 per cent of capacity. Some of the larger and best known plants building standard lines of machine tools operate at about 60 per cent capacity, and a few of the plants engaged in building special types are having all the business they can handle. In a few instances plant operation is limited not by lack of prospective business but by a scarcity of skilled labor.

Radial drilling machines and planers have been in greater demand of late than most other types of standard tools, although lathes also find a steady market. Several price advances have been made, and as long as buyers expect as much free engineering service as they do at present, coupled with higher labor and material costs, further price advances may be expected. One prominent machine tool builder states that with the amount of free engineering service demanded by some of the machine tool buyers—service that should be paid for as a separate and distinct item—prices of machine tools must continue to advance. This service, he finds, is a more important item in increasing costs than either increased material or labor charges. Among more recent price advances is a line of open-side planers which has been increased 10 per cent; a line of grinding machines in which price increases vary from 10 to 40 per cent, according to size and type of machine; and a well-known make of milling machines that has advanced 10 per cent.

The demand for heavy power presses is good, and one of the leading makers states that his output is limited only by the available supply of labor. The pressed-steel shops in the Detroit and Toledo districts are fully occupied, one plant in which 60 per cent of the output is for automobile purposes and 40 per cent for general industrial purposes, employing a night force to take care of the constantly increasing volume of business.

In the gear-cutting shops, 100 per cent activity is in evidence wherever automobile gears are produced. Jobbing shops in the Philadelphia, Pittsburg, and Cleveland districts are operating at about 75 to 100 per cent of capacity, gears being in demand for practically all industrial fields, steel mills, mines, paper mills, electric railway cars, and grain elevators. The demand for tractor gears, for which some of the gear-cutting shops are well equipped, is still very small.

The Small Tool Industry

The volume of sales in the small tool field is increasing at a steady pace and may be considered close to what may now be called "normal." The moderate price increases in small tools merely bring the price levels for products in this field more nearly up to par with prices for other commodities.

The demand for cutters, reamers and gear hobs keeps many of the plants in these fields fully occupied. The market for broaches is fair, with an increasing demand for broaching machines. Several hacksaw manufacturers state that their plants are fully occupied. There has been a slight increase in hacksaw prices, but they are still low compared with other metal products. Production methods in the manufacture of hacksaws have, however, been considerably improved in many instances, enabling manufacturers to sell at a price that is not far above the pre-war level. The demand for hacksaw machinery and power cutting-off machines is stated by various makers to vary from 50 to 100 per cent of normal. The volume of business in pneumatic tools is greater than before the war, but as the facilities for manufacturing these tools were enormously increased during the war, manufacturers in this field are still far from capacity output.

The Iron and Steel Industry

Production in the iron and steel field has now reached over 93 per cent of the theoretical capacity, but as a matter of fact, this is about as high a rate of output as the industry has ever been able to attain. The present output is limited only by the labor supply, and conditions in the steel market are now much the same as in 1920 just before the unprecedented rise in prices took place. The accumulated orders mount higher week by week, as shipments fall behind demand. Decided price advances have been made in spite of the fact that costs are reduced by the present activity in production. It is believed that those who control prices in the iron and steel field will not permit basic prices to go any higher, lest there should be a recurrence of the experience in 1920; but premiums for immediate delivery are beginning to be more common, and the scarcity of steel is felt in some localities. The rise in prices, instead of discouraging buyers, has brought them into the market.

Eighteen additional blast furnaces were being blown in during March, tube and rail mills are fully occupied, and the exports of iron and steel products is beginning to increase. March broke all pig iron production records with an output of over 3,521,000 tons, passing the peak production reached during the war—in October, 1916. On April 1, altogether 293 blast furnaces were in action, producing nearly 3000 tons of pig iron a day in excess of the highest average peak production during the war. The great activity in the iron and steel field is also indicated by the demand for electric furnaces in both steel mills and foundries, and for heat-treating purposes.

The Automobile Industry.

The production of automobiles is increasing. While complete figures are not yet available for the month of March, figures for February show that in spite of the shorter month the total number of cars produced was the largest in the history of the automobile industry with the exception of June, 1922. The number of cars produced per working day was greater than ever before, aggregating over 11,000. From March 1, 1922, until February 28, 1923, 2,600,000 passenger cars were produced, representing an average of 217,000 per month, or 40 per cent above the 1920 monthly average, which was the high peak up to that time. The output of the trucks averaged 21,000 per month. The total February production was 271,000 cars, the production of Ford cars being nearly one-half of this, or 130,000 cars.

The higher priced cars are now in greater demand than they were last year. The Pierce-Arrow Motor Car Co. announces that the sales this year have been over 225 per cent greater than for the corresponding period a year ago. If the present demand is maintained, the sales of this company's cars will exceed that of any previous year.

Some of the automobile manufacturers are hampered in their output by the steel shortage, and may have to curtail production because of the longer deliveries now prevailing. On the whole, the industry is more conservative than in 1920, and materials, tools, and equipment are ordered only as they are definitely needed to take care of present production, while in 1920 orders were placed in anticipation of future production that never materialized.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

Cincinnati Simplified Gear-Hobbing Machine

CONTINUOUS production of high-class gears, without the necessity of repeated and inconvenient adjustments, is the chief claim made for a recently developed gear-hobbing machine, which, when supplied to a customer, is arranged for cutting gears of only one pitch and one number of teeth. However, provision is made for easily adapting the machine to cutting gears of any other pitch and number of teeth within its range. This machine is known as the "Cincinnati simplified gear-hobber," and is built by the Cincinnati Gear Cutting Machine Co., Elam St. and Garrard Ave., Cincinnati, Ohio. The chief improvement in construction made by designing the machine for the quantity manufacture of gears of one pitch and one number of teeth, is in the simplicity of the indexing mechanism. The reduced number of parts in this mechanism lessens lost motion and wear, and increases the rigidity of the machine, which, in turn, increases its accuracy.

This machine is designed with a view to maintaining unusual accuracy in quantity production, and may be applied both to producing finished gears or gears that must be ground later. To produce an accurate gear by grinding, it is highly desirable that the blank be cut as nearly perfect as possible in order that the stock to be removed by grinding will be reduced to the minimum. Tests have shown all measurable mechanical errors in the tooth space and form to be eliminated in the finished product, this accuracy being attributed to the simple indexing mechanism and the rigidity of the machine. Subsequent grinding is said to be necessary only for correcting inaccuracies resulting from hardening. The machine has a capacity for cutting steel

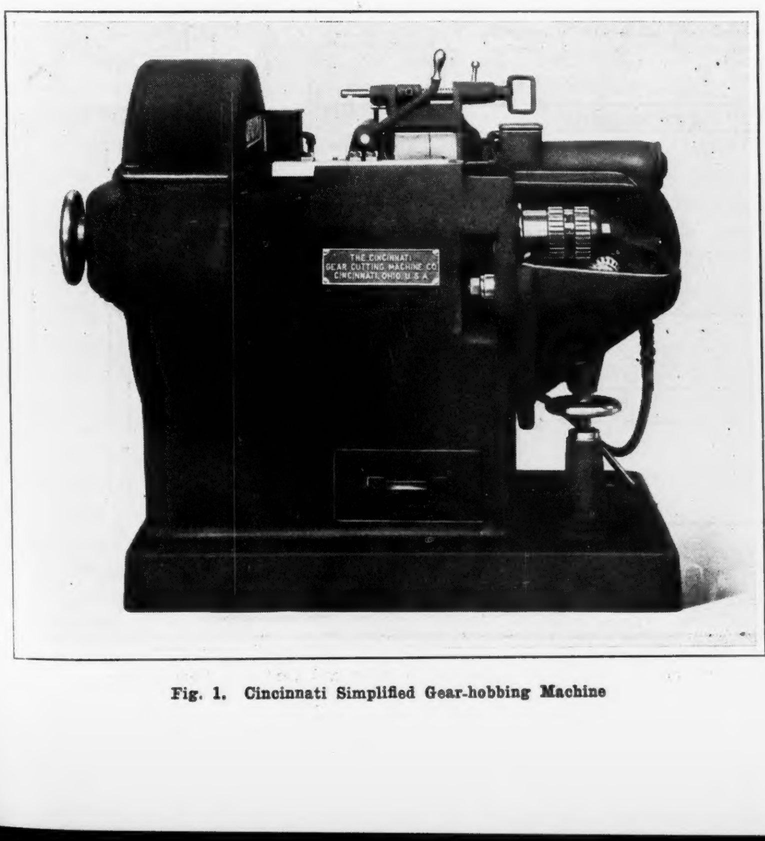


Fig. 1. Cincinnati Simplified Gear-hobbing Machine

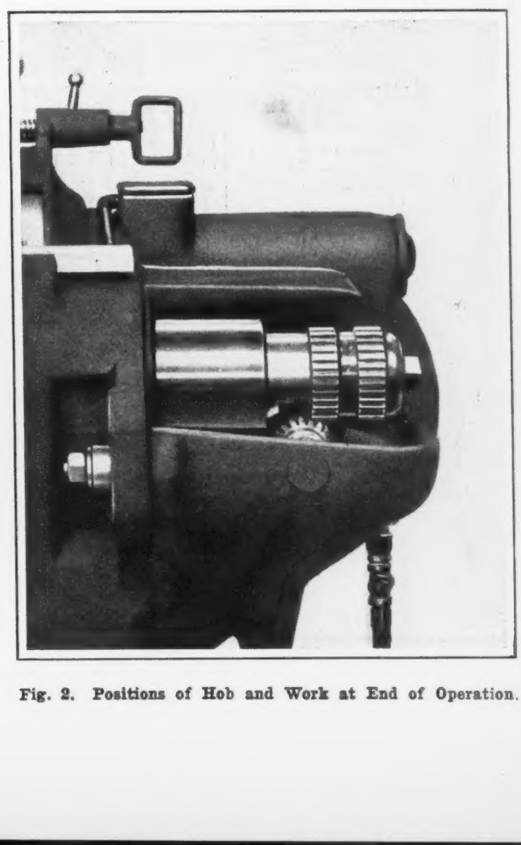


Fig. 2. Positions of Hob and Work at End of Operation.

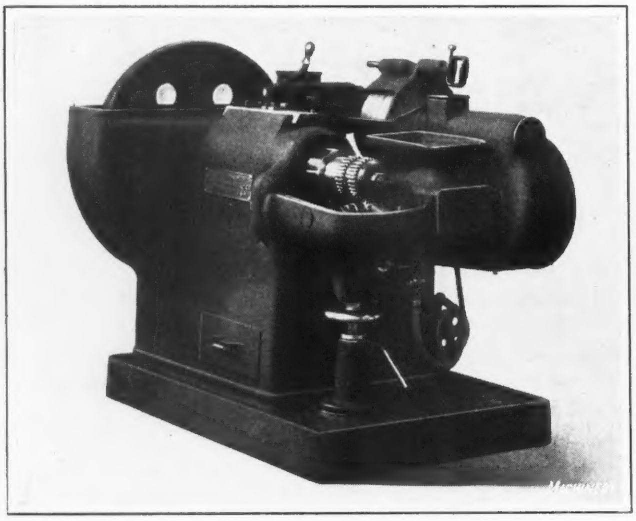


Fig. 3. View of Machine from Right-hand End, showing the Hob-spindle Housing and Micrometer Jack

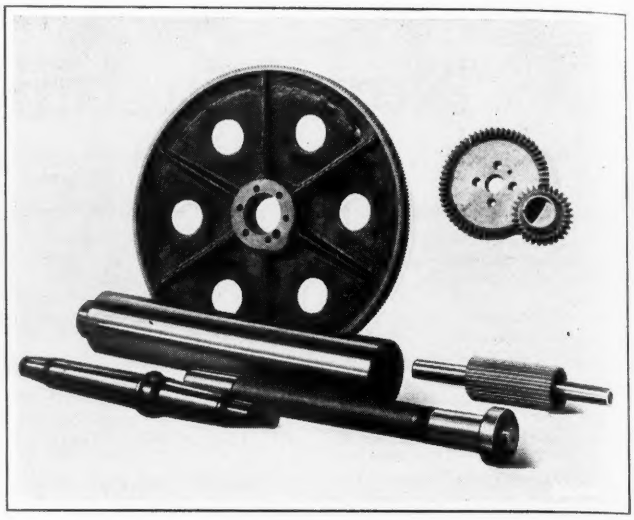


Fig. 4. Seven Parts, including the Hob- and Work-spindles, which constitute the Entire Indexing Train

gears up to 7 inches in diameter, $4\frac{1}{2}$ inches face width, and 4 diametral pitch.

The Hob-spindle and Housing

The front view of this gear-hobbing machine, illustrated in Fig. 1, shows the relative positions of the hob- and work-spindles when the work-spindle is in the loading position, while Fig. 2 shows the position of the work-spindle at the completion of the operation. Referring to the sectional view, Fig. 5, it will be seen that the hob-spindle *C* is driven by flywheel *A*, the teeth *B* of the flywheel engaging an eight-thread worm on the driving shaft. The flywheel is mounted directly on the hob-spindle, so that the momentum and balancing effect resulting from its weight of 300 pounds is carried directly to the hob. The hob-spindle is hardened and ground, and is provided with two opposed taper bearings, which are adjustable. There is a thrust collar *D* between the two bearings to insure that an adjustment of one bearing will not affect that of the other.

The hob-spindle housing is bored from the solid to suit the angle of the hob. The hob is set for the proper depth of cut and adjusted to suit the diameter of the gears through a radial movement imparted to the hob-spindle housing by the micrometer jack located below the chip pan, as seen in Fig. 3. This radial movement of the housing centers about driving shaft *J* of the indexing mechanism. Clamping bolts prevent a change in the position of the spindle housing after a setting has been made. The machine is furnished with a hob-spindle housing bored to the proper angle for cutting gears of any one pitch, but the housings are made interchangeable so that a machine equipped for cutting gears of one pitch can be quickly converted by the user to adapt it for cutting gears of any other pitch desired. No provision is made in the machine itself for changing the speed of the hob, and so the desired speed must be obtained through the ratio of the driving pulleys on the machine and the lineshaft. While any diameter or bore of hob can be used in the machine, a 4-inch diameter hob with a narrow face and a

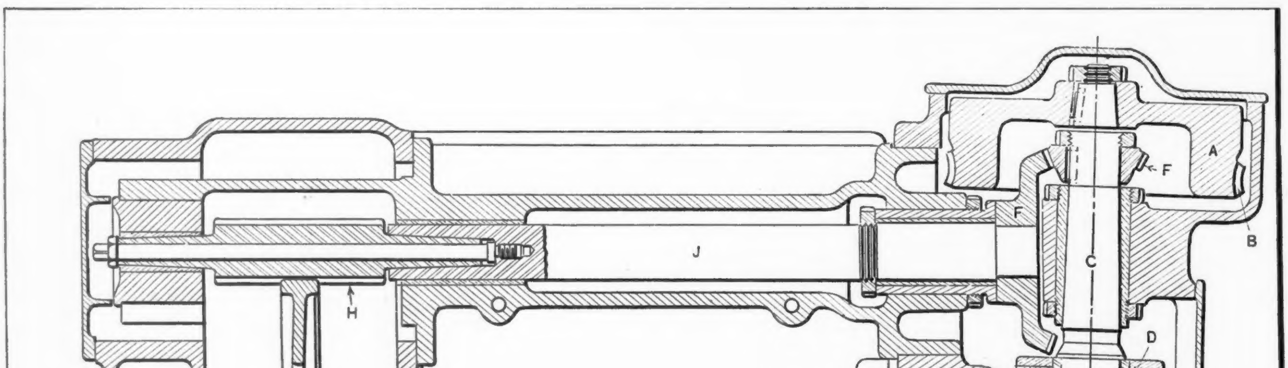


Fig. 5. Sectional View, showing the Design of Hob and Work-spindles and Means employed to index and feed the Work-spindle

2-inch bore is recommended. Such a sized hob has resulted in more accurate gears than smaller hobs. The large diameter directly reduces the depth of the feed marks.

Work-spindle and Indexing Mechanism

Work-spindle *E*, Fig. 5, is 6¾ inches in diameter, hardened, ground, and lapped. Like the hob-spindle, it is mounted in adjustable bronze bearings, but these are tapered on the outside. The size of the work-spindle and the design of its bearings (as is also the case with the hob-spindle) eliminates the necessity of outer supports. Attention has already been called to the simplicity of the machine, as emphasized in the indexing mechanism; the entire train consists only of the seven parts illustrated in Fig. 4, which include both the hob- and work-spindles. The proper relative rotation of the hob- and work-spindles is obtained through only four gears and the index driving shaft.

Referring again to Fig. 5, it will be seen that power for the indexing mechanism is transmitted from the hob-spindle through bevel gears *F*, and delivered through shaft *J* to the wide-faced pinion *H*. This pinion drives the index master gear *G*, which is mounted directly on the left-hand end of the work-spindle. The spur gears are accurately cut, and any error that might in time be produced by wear, becomes insignificant when transmitted to the work because of the comparative sizes of the master gear and the work, the former being approximately 34 inches in diameter. The machine can be adapted for cutting gears of different numbers of teeth by changing master gear *G* and pinion *H*.

The work is fed past the hob by lead-screw *K* running in nut *L*, the latter being mounted inside the work-spindle. Thus the rotation of the work-spindle in indexing also results in its being advanced according to the lead of screw *K*. Different feeds may be obtained by changing the lead-screw and nut. The work-spindle is returned to the starting position by revolving the lead-screw. Another unusual feature for machines of this class is the provision of intermittent feeds, by means of which the work is advanced rapidly to the hob, then fed at the proper rate until the teeth have been cut and finally stopped automatically at the end of the operation. After the work has been removed, the machine is tripped by the operator to throw into motion a quick return of the spindle to the loading position.

The compact and simple design of the machine, the heavily proportioned members, and the ample bearing surfaces are said to insure gears in which a constant tooth form and spacing is maintained around the periphery of any one gear and of all gears cut by the same hob. Increased production is claimed because of the elimination of shut-downs for making adjustments, repairs, or frequent changes of hobs, the use of increased feeds, the quick reloading facilities made possible because of the absence of outer supports for the hob- and work-spindles, the automatic quick traverse, and the reduction of rejections in the inspection department. Automatic oiling is provided for all parts of the machine.

GARDNER AUTOMATIC DOUBLE-DISK GRINDING MACHINE

The rapid grinding of parts having two opposite parallel sides of approximately equal area, such as piston-rings, ball- and roller-bearing races, gear blanks, solid dies, and adding machine parts, can be accomplished on the No. 2 automatic double-disk grinding machine now being built by the Gardner Machine Co., 414 E. Gardner St., Beloit, Wis. This machine is fully automatic when equipped with a continuous feeding magazine, but it may also be fed by hand, in which case its operation is semi-automatic. The most unique feature is that the grinding heads are mounted on offset spindles, so that the grinding operation is performed by the back face of one wheel and the front of the other. This arrangement of the heads permits quick and accurate dressing of the grinding disks, without altering the set-up, and on piston-rings, thrust collars, and other circular work the arrangement causes the piece to revolve rapidly during the grinding, which results in a high degree of accuracy in the finished part.

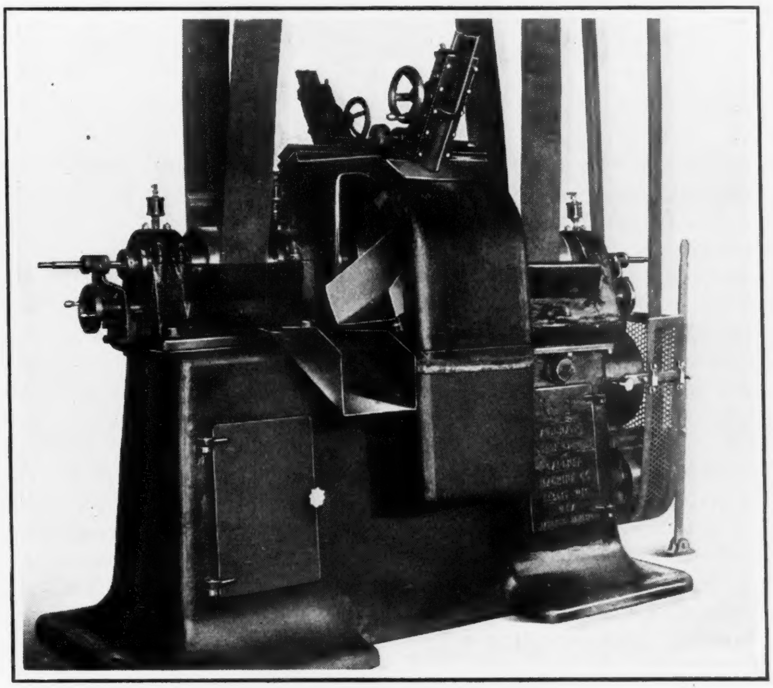


Fig. 1. Gardner Automatic Double-disk Grinding Machine for Parts having Two Parallel Sides of about Equal Area

The grinding members, when the work is to be ground dry, consist regularly of 18-inch diameter steel disk wheels, faced with heavy-type abrasive disks. However, when the work requires a coolant, 18-inch diameter ring-wheels are furnished, which are carried in chucks designed especially for this type of machine. The parts to be ground are conveyed to the grinding position by a carrier which passes between the grinding disks. In order to accommodate a considerable variety of work, including pieces having a large surface on which much stock is to be removed, as well as pieces with a small area over which only a light cut is necessary, this carrier is provided with a range of feeds varying from fifteen to sixty pieces per minute. The rate of feed may be further reduced to from four to fifteen pieces per minute by changing a pulley on the countershaft.

From six to twelve openings are cut in the carrier as shown in Fig. 2, to receive the work. These openings may be made to conform to the shape of practically any piece for which the machine is adapted, and by means of inserts one carrier can often be used for several sizes of similar parts. Special carriers can be made for operations in which the machine attendant loads and unloads the work. As the work approaches the grinding position, the right-hand disk automatically advances until it reaches a positive stop. This disk is applied to the work under an adjustable spring pressure governed by a cam, and consequently it advances only as rapidly as the stock is removed, giving a constant pressure against the work. The disk is returned to the open position by the action of the same cam, while the work is automatically unloaded as it passes out from the wheels.

Construction of the Grinding Head

The spindles are made of heat-treated alloy steel and are equipped with bronze bearings of special design. The

bearings are tapered on the outside and are fitted into correspondingly tapered cast-iron sleeves having means for drawing the bearings into the sleeves to compensate for wear. End thrust on the spindles is carried by hardened and ground steel collars, which bear directly on the spindle bearings, adjustment for thrust being provided by means of a nut and lock-nut on the spindle at the opposite end of the bearing. All bearings are adequately protected from dirt or dust, and they are thoroughly lubricated.

The grinding heads are heavy, rigid, one-piece castings, weighing about 275 pounds each. They are mounted on sub-bases, on which they are adjustable by means of a hand-wheel-operated micrometer screw graduated to 0.001 inch. This adjustment permits quick, accurate setting of the grinding disk or ring-wheels to compensate for wear. The sub-bases are also adjustable along the main base of the machine, for convenience in setting up a job requiring greater distance between the grinding disks than is obtainable through the screw adjustment. In its lateral movement the right-hand head slides on ways which are planed and scraped, amply lubricated, and guarded against dirt.

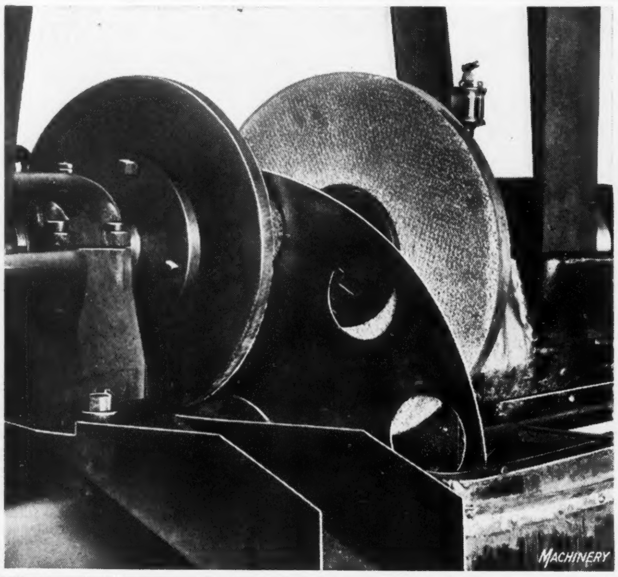


Fig. 2. View showing the Offset Relation of the Grinding Wheels and also the Work-carrier

Design of the Grinding Disks

A backing plate fills the center hole of each grinding wheel so that it is impossible for work to fall into this opening. The plate is part of a hollow shaft which extends the entire length of the spindle, and it is so arranged that no adjustment is necessary after the first set-up. In other words, the adjustment of the backing plate is entirely separate from the adjustment for wear of the grinding wheel. The hollow shaft carries coolant to the disks when wet grinding is being done. The flanges, on which the grinding wheels are mounted, are of large diameter so as to provide a support well out toward the periphery of the wheel.

A cast-iron hood guards the grinding disks, and when the machine is equipped with standard shields and attached to an exhaust system, all dust produced in grinding is removed. Naturally, to produce flat work of uniform thickness, the alignment of the spindles must be carefully maintained, and therefore an adjustment is provided to permit aligning the spindles in the event of wear of their bearings or other surfaces.

The Dressing Device

In grinding machines, an efficient truing device is one of the essentials in the production of accurate work. In this machine, two truing devices form an integral part of it. As shown in Fig. 3, these dressers are mounted on rigid slides, carried by the cast-iron hood previously referred to. Lateral adjustment to compensate for wear of the grinding wheels is obtained by means of a screw. In truing the wheels, the dressers are traversed on the vertical slide by rotating a handwheel, the drive being transmitted to the dresser through a rack and pinion.

When the machine is equipped for wet grinding, a tube for carrying the coolant to the work passes through each hollow spindle. This tube is connected at the outer end with a pump, and the inner end terminates in the backing plate of the grinding disk. Each tube has a number of holes at a point just behind the backing plate through which the coolant is ejected, thus being delivered to the center of the grinding disk and insuring flushing of the entire wheel face, as well as flooding of the work.

Automatic Feeding Device

Automatic feeding of such work as piston-rings thrust washers and ball races into the work-carrier is accomplished by means of the device illustrated in Fig. 4. This mechanism presents the work to the carrier one piece at a time,

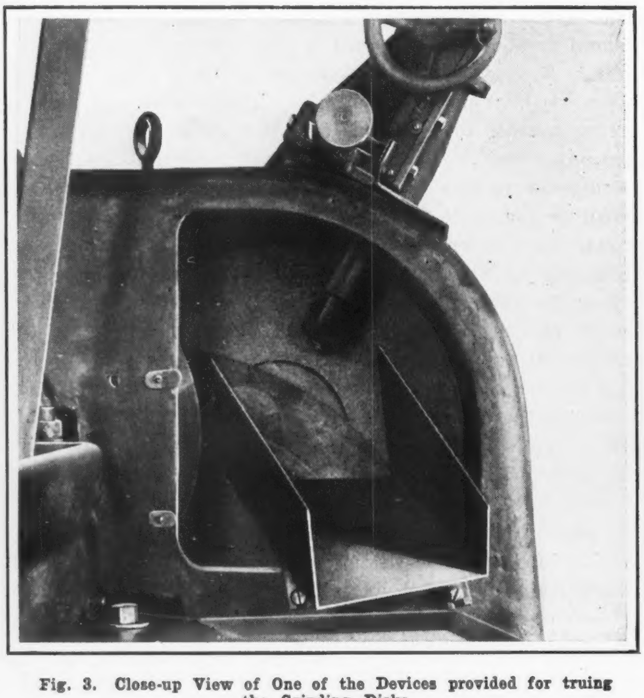


Fig. 3. Close-up View of One of the Devices provided for truing the Grinding Disks

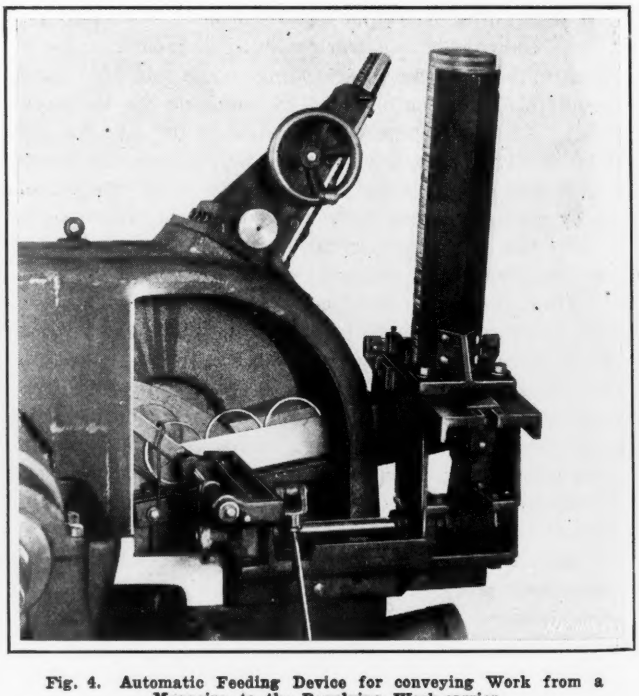


Fig. 4. Automatic Feeding Device for conveying Work from a Magazine to the Revolving Work-carrier

and because of the pieces being delivered by a mechanical means, the last piece in the magazine is fed just as efficiently as if the hopper were full. Larger work than mentioned, or irregularly shaped pieces, are preferably fed by hand or by means of a trough arrangement, with which the machine may be readily provided.

Some of the principal specifications of this machine are as follows: Maximum distance between disk wheels, 12 inches; maximum distance between new ring-wheels, 6 inches; diameter of hole in abrasive disks and ring wheels, 7 inches; height of spindles from floor, 40 inches; spindle speeds, 1400 revolutions per minute; countershaft speed, 560 revolutions per minute; power required for maximum duty, 15 horsepower; floor space required, 4 by 8 feet, and weight for domestic shipment, 4250 pounds. This machine is furnished for belt drive only.

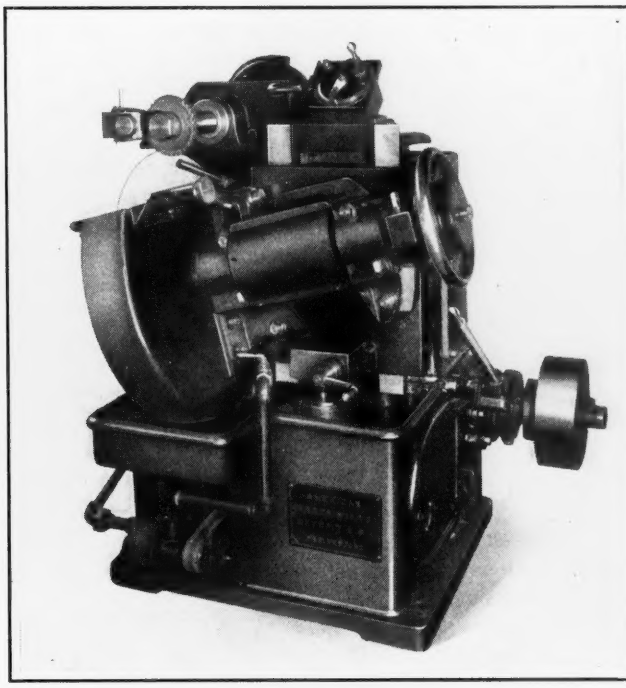


Fig. 1. Machine for grinding the Teeth of Spur Gears to obtain Accurate Tooth Form and Spacing, and Concentricity of the Pitch Circle

AMERICAN SPUR GEAR GRINDING MACHINE

For grinding the teeth of spur gears to obtain accurate tooth contour, tooth spacing, and concentricity of the pitch circle with the bore, so that the gears will be quiet, smooth-running and durable, the American Gear Grinder Co., 6534 Benson St., Detroit, Mich., has brought out a grinding machine having a number of interesting features. The special field of application of this machine is the production of hardened steel gears for automobile transmissions. Close working limits for the tooth form and tooth spacing may be eliminated in cutting the soft gear, thus doing away with fine finishing cuts, burnishing, etc. It is said that in many cases the total grinding time is less than the time required for the finish-cutting operation.

The action of the carriage relative to the grinding wheel generates a true involute curve on the gear teeth; however, this curve may be varied so that any desired tooth contour and dimensions within reasonable limits can be obtained. The machine is adapted for grinding the teeth of spur gears with pressure angles up to 25 degrees, of any diametral pitch from 12 to 3, of any pitch diameter from 1½ to 8 inches, and up to 1½ inches face width.

Construction of the Machine

The relation of the grinding wheel to the work-carrying mechanism may be clearly seen in Fig. 2, the guards having been removed in this view. The work-arbor seats in a large taper hole in a spindle mounted in a sliding carriage, the latter being actuated by means of a drum cam in the bed of the machine. On the opposite end of the work-spindle from that on which the work is mounted, there is a cylinder of approximately the same diameter as the pitch diameter of the gear to be ground. From Fig. 3 it will be seen that wound around this cylinder are two pairs of thin steel tapes, which are anchored both to the cylinder and to a rigid bracket. Thus as the work-carriage slides back and forth, the work-spindle is oscillated by the tapes winding and unwinding on the cylinder, the action being the same as that of rolling a perfect gear in a perfect rack. By this arrangement the gear tooth is rolled against the face of the grinding wheel. The bracket to which the tapes are anchored can be adjusted for height to accommodate various sizes of gears, and there is an adjustment to compensate for the corresponding difference in tape length.

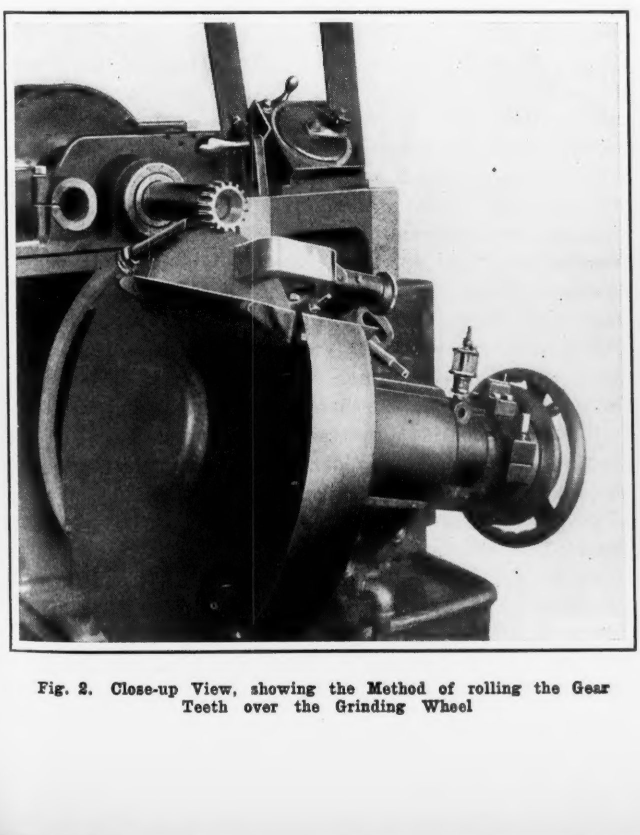


Fig. 2. Close-up View, showing the Method of rolling the Gear Teeth over the Grinding Wheel

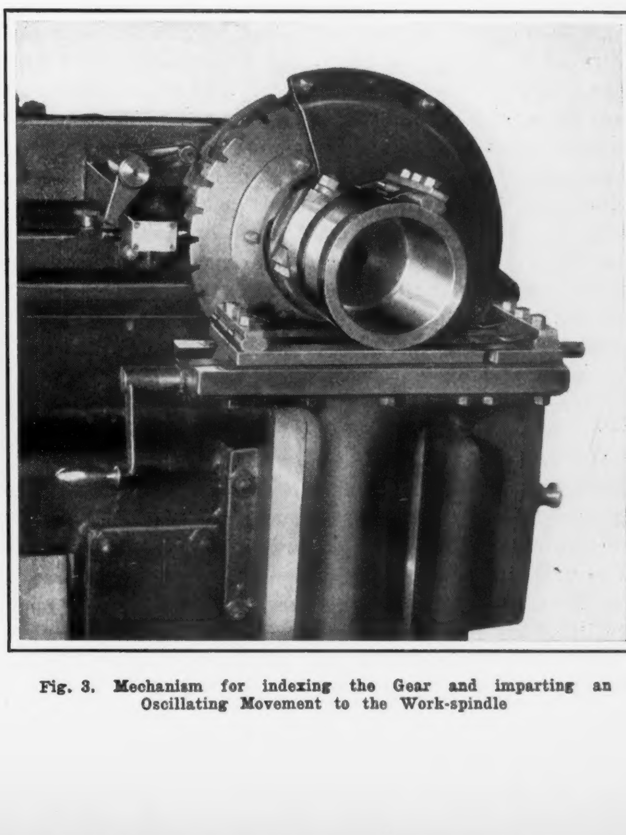


Fig. 3. Mechanism for indexing the Gear and imparting an Oscillating Movement to the Work-spindle

All control levers are within easy reach of the operator, and the heavy and high-speed units are mounted low, while the work-arbor and its slow-moving carriage is located above the grinding wheel. Other features include an automatic stop for the work-carriage; a reversible wheel-head which can be set either side of the center to the desired grinding angle for grinding both sides of a tooth; a centrifugal water pump, and a removable tank. The machine is self-contained, and so can be driven by belt directly from a line or countershaft or from a motor which may be located in the base. All parts are sturdily constructed with a view to eliminating vibration and producing practically perfect gears.

Carriage Drive and Automatic Stop

Only four gears are used in the entire machine; these are contained in the carriage cam drive, two of them being speed-change gears. The drum cam provides a positive reversal of the carriage and a ready means of cutting down the grinding time per tooth. The latter is accomplished by moving the carriage rapidly during the indexing and at a moderate speed when a gear tooth is in mesh with the grinding wheel. Change-gears provide for grinding one side of a gear tooth at the rate of four, five or six seconds, and means are incorporated within the bed of the machine to change the length of the carriage travel and its position. The carriage is controlled by an automatic stop mechanism on top of the wheel column, as shown in Figs. 1 and 2, which may be set to grind from one to sixty teeth. After the last tooth has been ground, the carriage is stopped with the gear free from the grinding wheel and in the proper reloading position. There is a device for locating the work in the proper relation to the grinding wheel.

Indexing Mechanism and Grinding Wheel Mounting

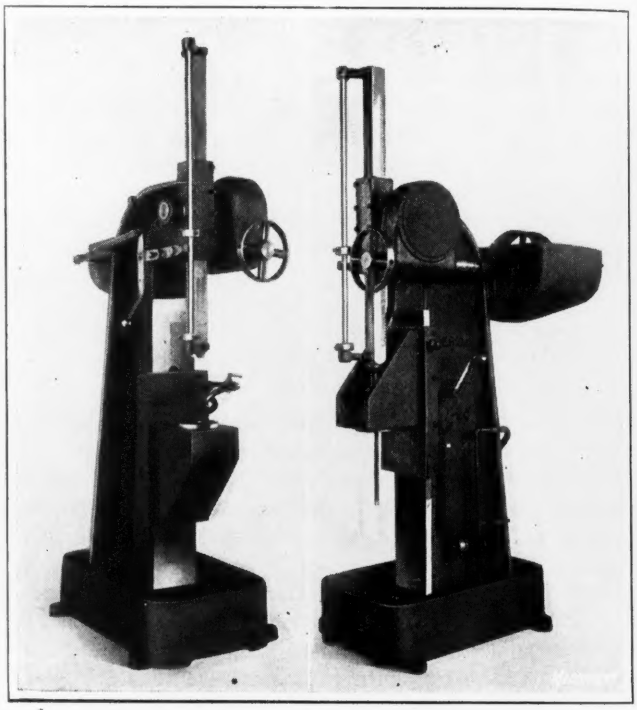
Proper spacing of the gear teeth being ground is obtained by utilizing the natural roll of the work-spindle for indexing the slotted disk, seen in Fig. 3, which controls the spacing. After the gear has been rolled to the right, out of the grinding wheel, a cam lifts the index-finger out of the index-plate slot that it happens to occupy. Simultaneously, a secondary plunger enters the same slot and holds the disk until the index-finger travels on the periphery of the disk to the next slot, drops into it, and again starts rotating the disk, at which time the secondary plunger is released. Less than one second is required to index a gear one tooth with this mechanism, and during the production grinding of 32-tooth gears of 6–8 pitch, the total accumulated error over eight teeth is said to have been only 0.0005 inch, while with stem gears of 16 teeth, 6–8 pitch, the total accumulated error over four teeth was but 0.0003 inch. The entire mechanism runs in a bath of oil, the oil pan and cover having been removed when the photographs were taken.

The grinding wheel is mounted on a 3-inch alloy steel spindle which is hardened, ground, and lapped, and which rotates in bearings made of Lumen bronze. These bearings are tapered on the outside to provide adjustment for wear. Horizontal adjustment of the wheel is obtained by rotating a handwheel graduated in thousandths of an inch, which is located at the right of the wheel-head, as shown in Fig. 1. A positive wheel-stop and a worm-driven wheel-truing device are provided. There is an elevating mechanism for the wheel-head, and the head can be swiveled either side of the center to any angle up to 25 degrees, as will be apparent from Figs. 1 and 2. An ordinary spur gear can be reversed in order to grind both sides of the teeth, but in the case of a gear that is integral with a shaft or cannot be reversed for some other reason, both sides of the teeth may be ground by swiveling the wheel-head in the opposite direction to that occupied in grinding one side, and reversing the setting of the grinding wheel on its spindle. The same work-holding arbors can be utilized.

One grinding cut is sufficient to provide a satisfactory finish on the average gear, but in cases of bad distortion, two cuts are necessary. When two cuts are taken, from 0.003 to 0.005 inch of stock is removed in the first cut, and 0.001 inch in the second. The heaviest cut that has been taken in tests conducted on this machine was on a 32-tooth, 6–8 pitch, 3/4-inch face, casehardened gear. This cut was 0.010 inch on all teeth, and the grinding time was three minutes. The gear tooth is ground by a perpendicular face of the wheel, 3/8 inch wide, the wheel being 24 inches in diameter. The shape of the wheel allows for over one inch of face wear, which should be sufficient, with careful truing, for grinding over 1000 gears of 32 teeth.

AMERICAN VERTICAL BROACHING PRESS

Both push- and pull-broaching, as well as assembly work, can be performed on a vertical broaching press equipped with a reversible knee, which has been brought out by the



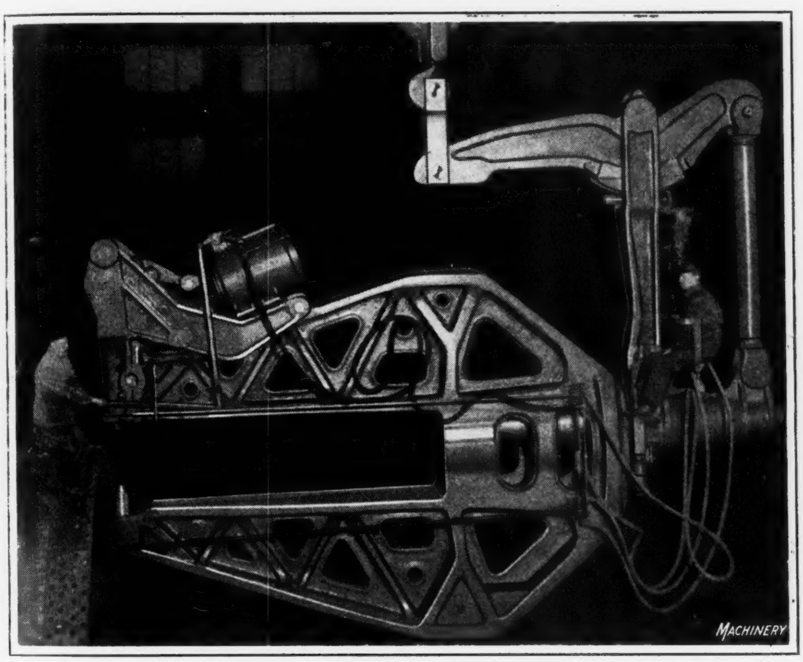
American Vertical Press for Pull- and Push-broaching and Assembling

American Broach & Machine Co., Ann Arbor, Mich. This machine is designated as the "V-20." That the machine is not limited to broaching is due to the fact that it is provided with a pair of friction clutches, which furnishes a flexible control for the drive. From the driving shaft, power is transmitted through a hardened steel worm and a bronze worm-gear, in a similar manner to the method used on the rack-operated horizontal broaching machine built by this company, the final drive to the steel ram being through a hardened pinion. The ram is 2½ inches square, and is provided at the lower or working end with a 2-inch tapped hole having eight threads per inch, to receive pull-bushings which are standard equipment for the horizontal machine. The new vertical machine has a pressure varying from 8 to 10 tons. Automatic stops facilitate the operation of this machine, and an oil-pump delivers lubricant to the broach from an oil reservoir formed by the deep base of the machine.

The reversible knee, previously referred to, pivots at the center of its slide so that the knee may be conveniently reversed to bring it into position for either push- or pull-broaching. At the left in the accompanying illustration, the knee is shown in position for push-broaching, while at the right it is set for a pull-broaching operation. In order to adapt the machine for pull-broaching when it is arranged for

push-broaching, it is only necessary to change the direction of the driving belts and reverse the links on the operating handle at the left-hand side of the machine. This alteration causes the power or cutting stroke to be made at a slow speed and the reverse stroke at a fast speed. The knee and slide are bored and bushed at the pivotal point, and in this bushing is placed a removable steel pinion of large size, which is used to lock the knee and slide to the face of the column. The latter is provided with a number of holes to permit locating the slide at different heights, and the slide is raised and lowered on the column to register with any of these holes by rotating the crank on the right-hand side of the machine, which actuates a pinion.

This machine is especially suitable for pull-broaching round holes, because the broach hangs in a perpendicular plane, which allows it to center itself in the work. The handwheel near the top of the machine is used for setting the ram and operating it by hand. Normally the handwheel "coasts" when the machine is in operation, but when it is desired to use it, a slight pressure endwise will cause it to engage a positive clutch. This machine receives broaches of the push type up to 20 inches in length, and pull-broaches up to 28 inches in length. The knee is bored 5 inches in diameter, with the bore located in line with the tapped hole of the ram. The machine weighs approximately 2200 pounds.



•Hanna Portable Pneumatic Riveter of Massive Proportions

HANNA 150-TON PNEUMATIC RIVETER

A 150-ton portable pneumatic riveter having a reach of 118 inches and a 30-inch gap constitutes the latest achievement of the Hanna Engineering Works, 1763 Elston Ave., Chicago, Ill., in the development of riveting equipment. This riveter is built primarily for fabricating the plates forming the volute of the casing and the penstock for a 70,000 horsepower hydraulic turbine built for the Niagara Falls Power Co. The greatest distance across the volute is 48 feet, and the diameter for the entrance of water is 15 feet. The plates vary in thickness from 1¼ inches at the entrance to ⅞ inch at the end, and rivets varying in diameter from 1 to 1½ inches are used. The longest grip of the 1½-inch rivets is approximately 5 inches. The penstock is approximately 18 feet in diameter, 110 feet long, and is constructed of 1½-inch plates. The total weight of the machine is approximately 57,750 pounds and, obviously, mechanical power is necessary to move the equipment into the operating positions.

The riveter is so designed that the spindle may be tilted and the frame swiveled into the necessary angular positions. The illustration shows the spindle approximately horizontal and the frame in a vertical plane with the riveting mechanism above. However, the frame may be revolved on the spindle into a horizontal plane and tilted upward 30 degrees from the horizontal or downward a similar amount. It may also be brought into a vertical position with the riveting equipment on the lower side.

The supporting mechanism is so designed that when the frame is revolved on the spindle or tilted upward or downward from the horizontal, the center of gravity of all the parts hanging from the crane hook is neither raised nor lowered. This is accomplished through the suspension beam at the top, two vertical links, the spindle housing, and the spindle, which form a parallelogram with an overhung support at the crane hook directly above the center of gravity of the entire machine. With this arrangement, the friction of the bearings and inertia are the only forces to be overcome. Power for the revolving and tilting movements is obtained from two reversible air-drill motors of approximately 2 horsepower which are manufactured by the Chicago Pneumatic Tool Co.

The motor for tilting is mounted on the inner vertical link and drives a worm that engages a worm-gear segment on the suspension beam, while the motor for rotating the frame is mounted on the spindle housing, and drives a full worm-gear on the frame. This construction makes it possible to set the frame at any angular position around the spindle. Incorporated in this driving arrangement is a means for absorbing the shock of stopping the massive frame, and roller and ball bearings are furnished at all points of rotation. The frame is mounted on the spindle on two radial roller bearings, and is restrained from longitudinal movement by two roller thrust bearings. All moving parts are lubricated by oil baths and a grease system.

The riveting mechanism is a combination of toggles, which merge into a lever action, developing a predetermined maximum uniform pressure during the lever action, which is obtained with the last half of the piston stroke, this being also the last inch of die travel. This insures the driving of absolutely tight rivets without the necessity of adjusting the die screw to compensate for ordinary variations in the length of rivets, thickness of plates, diameter of holes, etc. Complete manipulation of this machine is possible from one position at the head or dies, three valve-operating handles being located at that point for operating the riveting, rotating, and tilting mechanisms. The rotating and tilting motor valves may also be manipulated from a seat provided near the rear of the machine. In the latter case, use is made of standard reversing valves built into the motors.

COATS UNIVERSAL ANGLE-PLATE

Milling, drilling, and other operations in which the work must be placed in one or more angular or radial positions may be facilitated by the use of a universal angle-plate which has been placed on the market by the Coats Machine Tool Co., Inc., 112 W. 40th St., New York City. As will be apparent from Fig. 1, this device has a faceplate provided with T-slots for attaching work or special fixtures, and with an accurately machined hole at the center which receives plugs for centering the work on the faceplate. The faceplate is 6 inches in diameter, and the hole ¾ inch.

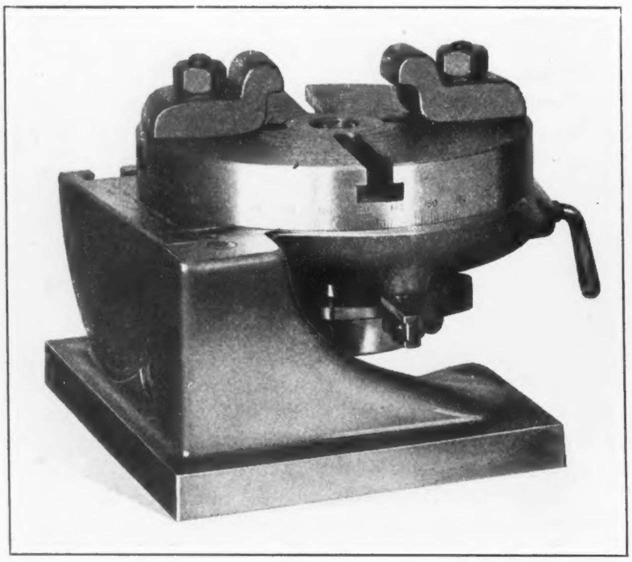


Fig. 1. Coats Universal Angle-plate for obtaining any Radial or Angular Position of Work

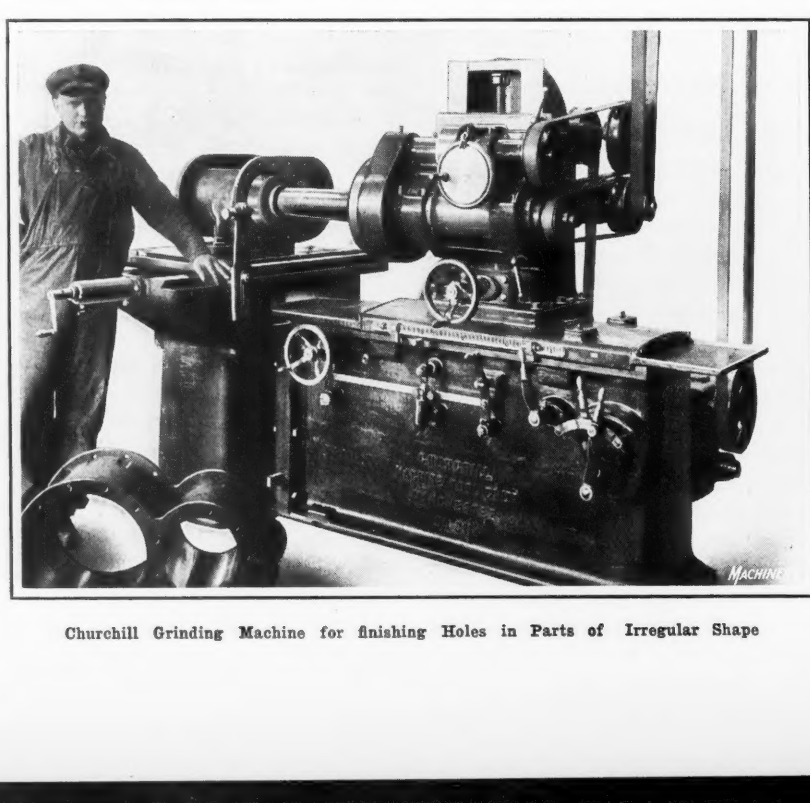
Fig. 2. View showing the Faceplate swiveled to a Position between the Horizontal and the Vertical

Accurate setting of the faceplate to any radial position is readily accomplished, graduations in degrees being provided around the periphery of the plate for this purpose. It will be seen from Fig. 2 that the faceplate may also be swiveled to any angular position from the horizontal to the vertical, and means are furnished for locking the faceplate in position.

Accurate indexing of the work is accomplished through an interchangeable index-plate and a hardened steel pawl beneath the faceplate. There are six index-plates which provide for indexing from 12 to 360 divisions about a circle. These index-plates are guaranteed to be accurate within 5 minutes. The clamps shown on the faceplate and bolts are supplied for securing this angle-plate to the table of the machine tool on which it is to be used, the bottom of the base being machined to insure a rigid set-up. The base, bracket and faceplate are chilled iron castings.

CHURCHILL CYLINDER GRINDING MACHINES

One class of work for which the cylinder grinding machines built by the Churchill Machine Tool Co., Ltd., Manchester, England, have been found especially suitable is grinding the cylinders of braking equipment of locomotives. These machines are designed for grinding holes in parts that, owing to their shape, cannot be rotated as required in grinding machines of the internal type. One of the machines is shown in the accompanying illustration. As the work may be of irregular outline or have overhanging projections, the machine is arranged so that it may be equipped with one of several tables. The table is mounted on a separate bed, which reaches to the floor and is bolted on one side to the bed proper of the machine. This method of assembly makes it convenient to equip the machine with a larger or smaller table as desired, or to substitute a base-plate for the table. The table has a cross adjustment which is used only in positioning the work, the table remaining stationary during the actual grinding.



Churchill Grinding Machine for finishing Holes in Parts of Irregular Shape

The grinding wheel spindle is carried in a head which is adjustable vertically on the column, the column being mounted on a slide which has an automatic longitudinal movement on the bed, controlled by reversing dogs. These dogs are adjustable to permit of varying the stroke of the spindle to suit the length of the hole being ground. The column slide is provided with various speed changes, and on two of the machines it has a quick traverse obtained independently of the reversing dogs. This quick traverse can be operated automatically for feeding the wheel at a high rate of speed over relieved or cored portions of long holes. The main spindle in which the grinding wheel spindle is mounted also has various speed changes which are independent of the table speed changes. The wheel-spindle is easily detached from the main spindle, so that larger or smaller wheel-spindles can be substituted in a few minutes. A full range of spindles may be furnished to adapt the machine to grinding all holes within its capacity.

On two of the machines, an adjustment of the planetary motion of the grinding wheel is obtained through double eccentric spindles, which are controlled by means of a differential mechanism, while in the larger sizes, this adjustment is obtained directly by means of a slide located at right angles to the main spindle and operated through a screw and differential motion. This construction provides a wide range of adjustment, so that wheels considerably smaller in diameter than the holes to be ground may be used. Under such a condition the arc of contact between the wheel and the work is reduced. The cross

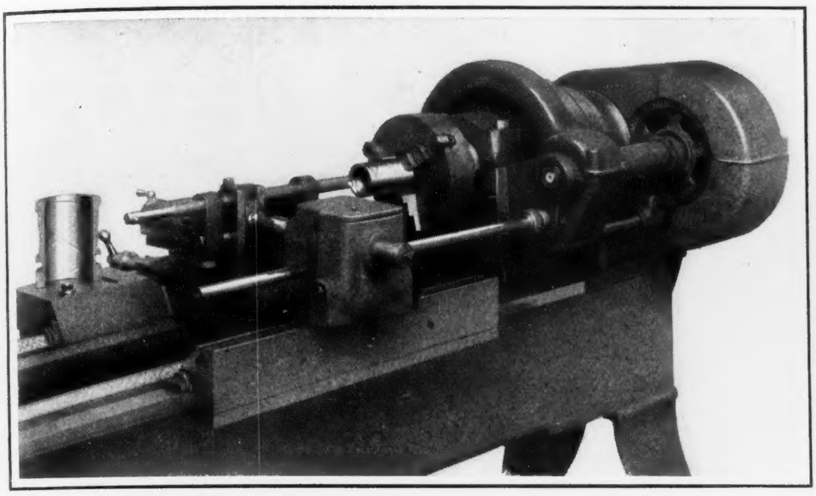


Fig. 1. Mueller Lathe Attachment for cutting Oil-grooves in Bearings or Shafts

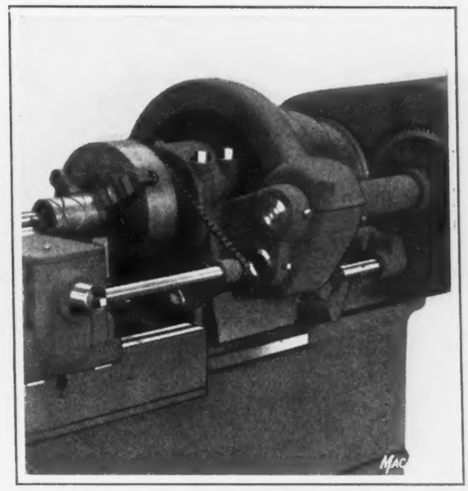


Fig. 2. Chain Drive for Oil-grooving Attachment

adjustment of the table and the vertical adjustment of the spindle make it possible to grind a number of holes in the work without disturbing the set-up. The machine may be driven from a countershaft or by a constant-speed motor.

MUELLER OIL-GROOVING ATTACHMENT

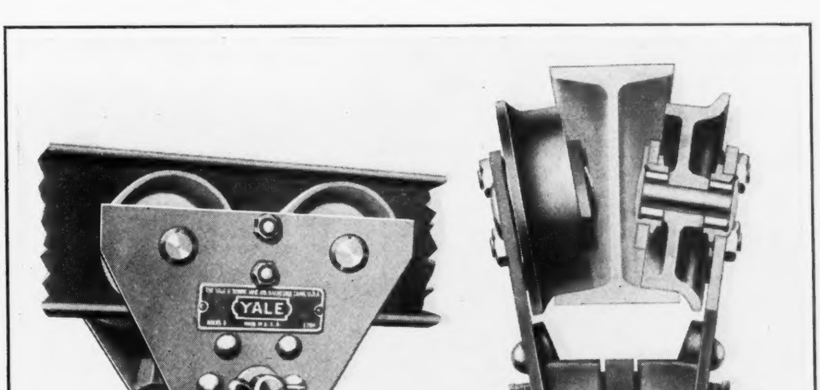
An oil-grooving attachment applicable to bearings or shafts of any size or shape that can be revolved in a lathe has been brought out by the Mueller Machine Tool Co., Cincinnati, Ohio. This attachment may be applied both to the lathes built by this company and to those of other makes. With it oil-grooves can be cut either single or double figure-eight style without rechucking the piece. The cutter-bar of the attachment has a double-pointed cutting tool, so as to groove consecutively on opposite sides of the hole in a bearing, the cutter-bar being fed longitudinally along the machine during the operation. The lathe spindle makes two revolutions to each complete stroke of the cutter-bar.

On engine lathes built by the Mueller Machine Tool Co., the driving shaft of the attachment enters the lathe head directly below the back-gear pinion, as shown in Fig. 1. The drive is transmitted through a rawhide pinion on the forward end of the driving shaft of the attachment, which meshes with the face gear on the lathe spindle. For other makes of lathes, a chain drive is furnished, as may be seen in Fig. 2. The sprocket gear on the nose of the lathe spindle is assembled before the chuck, a chain connecting this gear with a sprocket pinion which is fastened on the splined driving shaft of the attachment.

The driving shaft of the attachment is supported by an adjustable bearing made to suit any lathe, and it passes through a driving box bolted or clamped on the lathe carriage. This driving box contains a worm and worm-wheel, which transmit power to a splined shaft above, running at right angles to the driving shaft. At the front end of this upper shaft there is an adjustable graduated cross-bar, functioning like a crank, which traverses the cross-head that carries the cutter-bar. Any required stroke within a range of 1½ to 6 inches may be obtained through the adjustment. The cross-head traverses the cutter-bar back and forth in a support bolted on top of the compound rest. The cutting tool can be brought to any desired position while the lathe is in operation, and the cutter-bar can be raised or lowered to suit the center line of lathes of different swing. The sliding block in the cross-head has a ball-and-socket bearing, which enables the compound rest to be swiveled for grooving tapered holes and shafts.

YALE ROLLER-BEARING TROLLEY

A reserve strength of seven times its rated capacity and an unusual degree of flexibility are the main features claimed for a steel-plate trolley equipped with roller bearings, which has been brought out by the Yale & Towne Mfg. Co., Stamford, Conn. It is said that in a test the 2-ton size was loaded with a weight of 28,000 pounds, and although the standard I-beam on which the trolley was mounted broke under the load, the trolley was undamaged. The non-rigid construction of the trolley is such that the 1-ton size can be easily run around a track curve having a radius of only 21 inches.



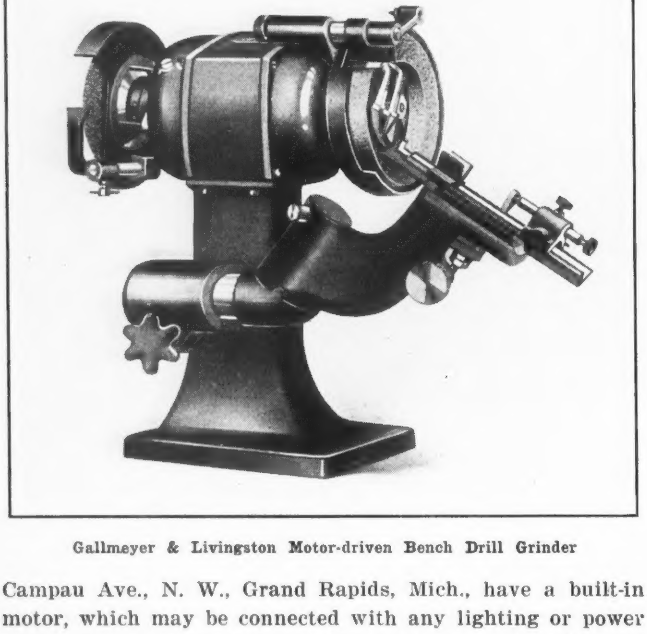
Yale Roller-bearing Trolley

The sectional view in the accompanying illustration shows the mounting of the wheels on the roller bearings, and the method of attaching the wheels to the side plates. The side plates, in turn, are connected by a single equalizing pin, which supports the shackle plate. Spreader castings riveted to each side plate give large bearing surfaces for the equalizing pin. These castings are shaped

to protect the trolley and act as a bumper for contacting the stop on the lower flange at the ends of the I-beam track. The roller-bearings are heat-treated, and hardened and ground. They assure easy lateral motion, and are provided with grease chambers. Each axle is set parallel to the upper surface of the lower I-beam flange, pressed into its wheel hub, and supported by an inner bearing plate. The wheels have chilled iron treads, designed to suit the shape of the I-beam flange on which they run. The equalizing pin is made of cold-rolled steel, and supports a shackle, eye, or clevis.

GALLMEYER & LIVINGSTON DRILL GRINDERS

Two motor-driven bench drill grinders, which are now being placed on the market by Gallmeyer & Livingston Co., successor to the Grand Rapids Grinding Machine Co., 14

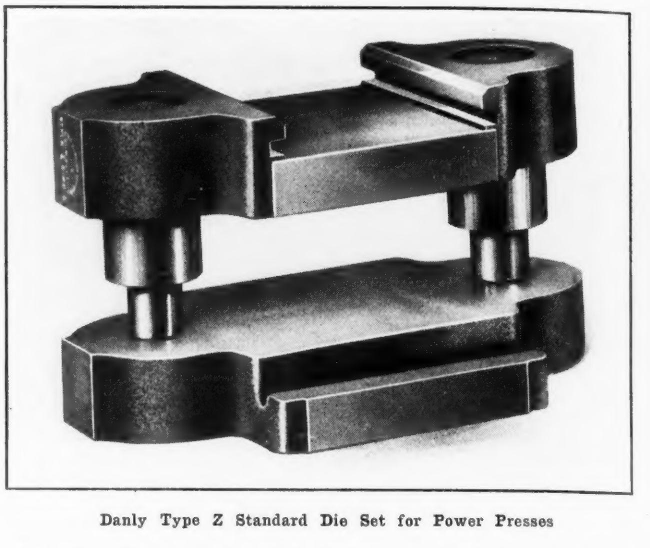


Gallmeyer & Livingston Motor-driven Bench Drill Grinder

Campau Ave., N. W., Grand Rapids, Mich., have a built-in motor, which may be connected with any lighting or power circuit. The ½-horsepower size carries an 8½-inch cup grinding wheel, and the ¼-horsepower size a 5-inch cup-wheel. The machine equipped with the ½-horsepower motor is made in two sizes, one for grinding drills from No. 52 to ¾ inch, and the other for drills from ⅛ inch to 1½ inches. The machine with the ¼-horsepower motor is believed to be the smallest drill grinder ever placed on the market. It is suitable for grinding drills from No. 60 to ⅜ incn. Both machines are equipped throughout with ball bearings, and are supplied with a wheel-truing diamond. These grinders are similar to the floor-type machine described in July, 1918, MACHINERY.

DANLY STANDARD DIE SET

Another addition has been made to the line of standardized die sets and component parts manufactured by the Danly Machine Specialties, Inc., 4911 Lincoln Ave., Chicago, Ill., in the type Z die set, here illustrated. This set is especially suited for the production of adding machine, typewriter, and similar stampings, which must be accurately made. A floating punch shank relieves the dies from all strains due to play in the ram of the press or other faults in the machine. The punch-holder is guided into the die by extra long, hardened, ground, and lapped bushings, which never leave the leader or pilot pins. Adapters that take the place of the punch shank can be made up by the user in either solid or swiveling types, and arranged for either a spring or a positive knock-out. A particular feature of the adapters is that they need not be removed from the ram

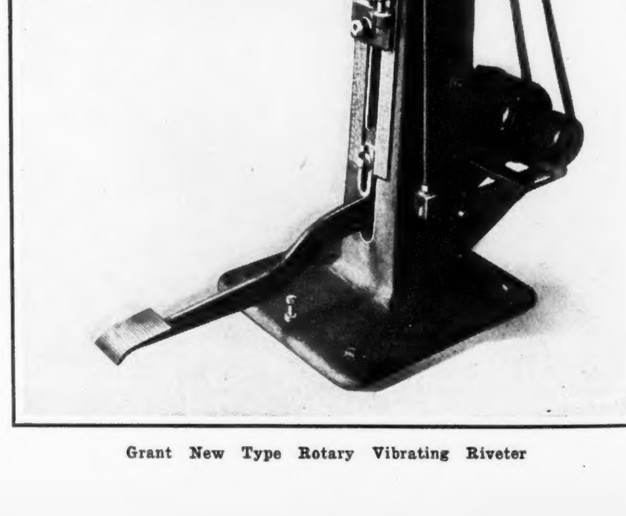


Danly Type Z Standard Die Set for Power Presses

when the dies are changed, it being only necessary to remove clamps from the shoe to permit sliding the die set from the adapters. Obviously, this feature provides for making set-ups quickly. The die-set parts are made of semi-steel and accurately machined. A complete range of stock sizes of this set accommodates dies from 4 to 10⅜ inches square.

GRANT ROTARY VIBRATING RIVETER

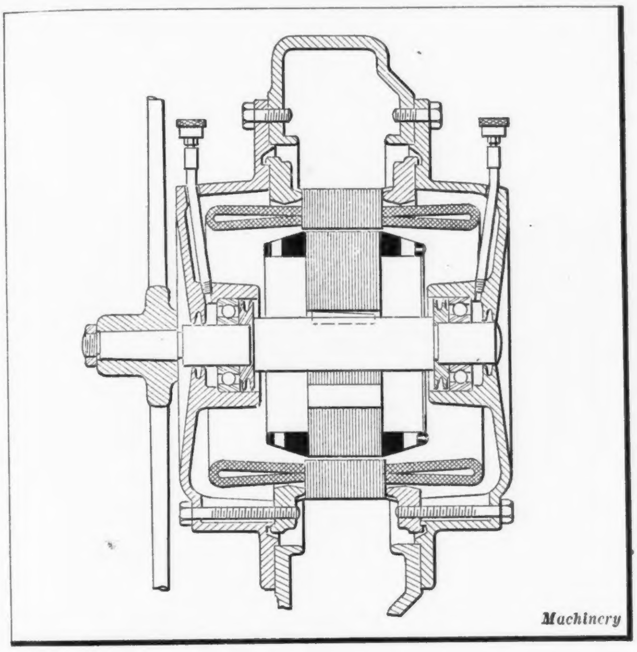
Sufficient depth of throat to permit handling a large variety of work is one of the features of the No. 4 rotary vibrating riveter recently brought out by the Grant Mfg. & Machine Co., N. W. Station, Bridgeport, Conn. This machine, which is shown in the accompanying illustration is designed to head rivets up to and including 5/16 inch in diameter. The riveter has a throat depth of 18½ inches, which provides for heading rivets at the center of a 36-inch circle. It is also built in a style arranged for belt drive, and fitted with a horn support used in riveting circular drums, such as fire extinguishers and other cylindrical articles.



Grant New Type Rotary Vibrating Riveter

OLIVER MOTOR-DRIVEN BAND SAW

The No. 16 band-sawing machine built by the Oliver Machinery Co., Grand Rapids, Mich., may now be equipped with a motor drive in which the rotor is mounted and keyed directly on the lower wheel-shaft within the column of the machine, as illustrated. Two ball bearings, supported by end bells reduce the friction of the shaft. The end bells have finished concentric tongues which accurately fit inside finished rings on the band-saw frame and on the stator, this construction insuring alignment and providing for easy accessibility. A two- or three-phase alternating-current motor running at 600 revolutions per minute is recommended for this type of drive. The machine is equipped with 36-inch wheels and accommodates work up to 36 inches wide



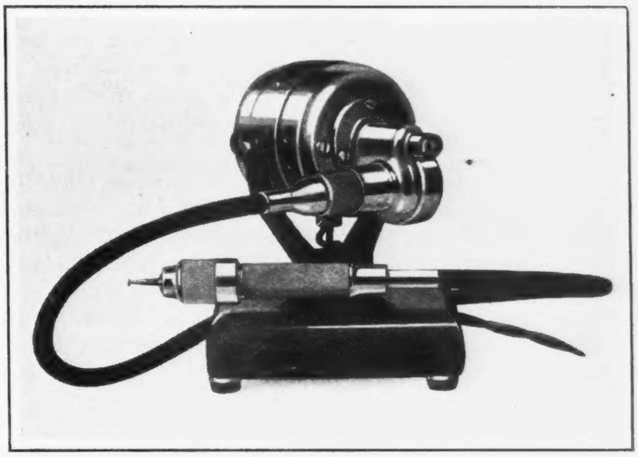
Sectional View of Novel Motor Drive on Oliver Band Saw

between the saw and the column, and up to 16 inches high under the guide. The table tilts 45 degrees to the right and 5 degrees to the left.

DUMORE UTILITY TOOL AND IMPROVED DRILL

To facilitate small-hole drilling, engraving, and die-sinking operations, especially in places that may be inaccessible with other types of equipment, the Wisconsin Electric Co., 2559 Sixteenth St., Racine, Wis., is bringing out the geared utility tool here illustrated. This tool is driven by a nickel-plated universal motor, which may be operated on either alternating or direct current, the motor being balanced dynamically to obviate vibration. The motor drives, through worm-gearing, one end of a flexible shaft, at the opposite end of which is mounted an aluminum hand-piece and a No. 0 Jacobs chuck. Convenient operation of the tool is provided for by having the motor pivotally mounted on the base. Chuck speeds from 500 to 2000 revolutions per minute are obtainable by means of a five-speed rheostat in the base; however a foot-control rheostat can also be supplied. The chuck takes tools from 1/8 inch diameter down to a No. 80 drill.

Attention is called to the Aluminum hand-piece, which is knurled and fitted with a double-row S K F ball bearing to take both end thrust and radial load. This construction is said to result in a smooth-running chuck and to prevent the hand-piece from becoming hot. A chuck guard permits the hand-piece to be held close to the work. This guard is made of brass and is removable from the hand-piece by



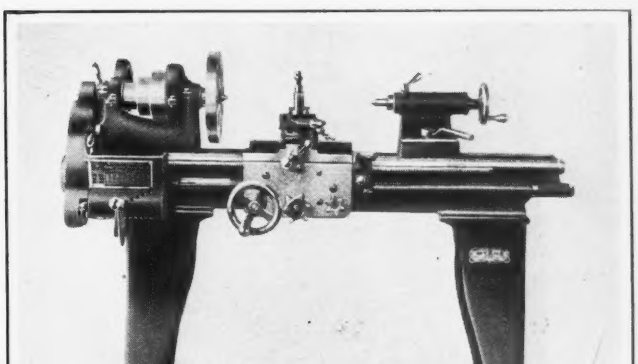
Dumore Utility Tool for Difficult Drilling, Engraving, and Die-sinking

giving it a single turn. An S. S. White No. 7 hand-piece may also be furnished with this equipment, together with a special adapter and a coupling.

The same company is also introducing to the trade an improved type A sensitive high-speed drilling machine for use in jewelry manufacture and similar work, where a machine designed for light work is required. This machine is similar in appearance to the one described in May, 1918, MACHINERY; but it is equipped with a universal dynamically balanced motor for operation on either alternating or direct current, the same as the utility tool. The drilling machine is equipped with a No. 0 Jacobs chuck, and a foot-controlled rheostat provides for regulating the spindle speed to meet the requirements of each job. This machine has a capacity for drilling holes up to 1/16 inch in diameter in steel.

MYERS SMALL-SIZE ENGINE LATHE

A 10-inch engine lathe equipped with a quick-change gear-box is the latest addition to the line of products manufactured by the Myers Machine Tool Corporation, Columbia, Pa. The machine has a maximum distance between centers of 24 inches, and is built both in floor and bench styles. The simplicity of its construction and convenience of operation will be apparent by reference to the accompanying illustration. The gear-box provides for cutting twenty-five threads, ranging from 6 to 52 per inch. For convenience in thread-cutting, the apron is equipped with a thread dial at the right-hand end, which makes it unnecessary to use a



Myers 10-inch Engine Lathe equipped with a Quick-change Gear-box

backing belt or a reversing motor in operations of this sort. The thread dial can be readily disengaged from the lead-screw when not in use, and the lead-screw is only used in thread-cutting, a rack on the bed and a pinion in the apron being used to feed the carriage longitudinally in other operations.

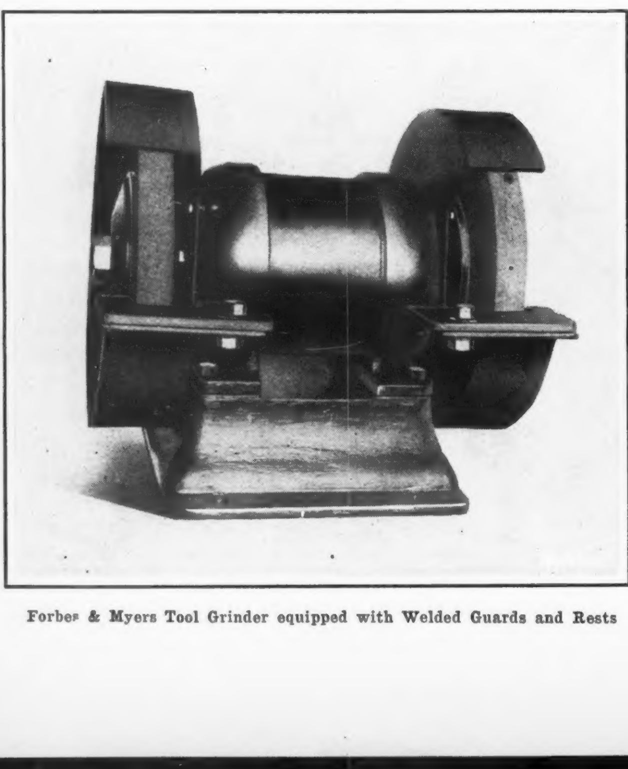
The compound rest is graduated in degrees, and the cross-feed is equipped with a micrometer nut. Clamping bolts provide for holding the compound rest in the desired setting. The swing over the rest is 6½ inches. The tail-stock is of the set-over type and does not interfere with swinging the compound rest at right angles to the cross-slide. The headstock spindle is made of open-hearth high-carbon steel, bored from solid metal and ground. The spindle socket is bored to a No. 3 Morse taper, and bushed for a No. 2 Morse taper. The hole through the spindle is 25/32 inch in diameter. The countershaft is provided with forward and reverse friction pulleys.

All gears on the lathe are adequately covered with guards, the guard for the change-gears at the left-hand end of the machine being of the swinging type so that they are readily accessible. Various attachments, such as a draw-in collet chuck and a taper attachment, may be furnished, and the lathe may be equipped with short legs in place of those shown, for installation on a bench. The weight of the floor and the bench type is approximately 400 and 360 pounds, respectively.

FORBES & MYERS TOOL GRINDER

A model No. 102 tool grinder, which differs principally from other grinders of this class made by Forbes & Myers, 178 Union St. Worcester, Mass., in that it is equipped with welded steel guards and rests, is now being introduced to the trade by this concern. Originally, this machine was supplied to a purchaser without either guards or rests, so that he might equip it as desired. Because welded steel guards and rests have proved satisfactory, the standard machine is now being furnished with them.

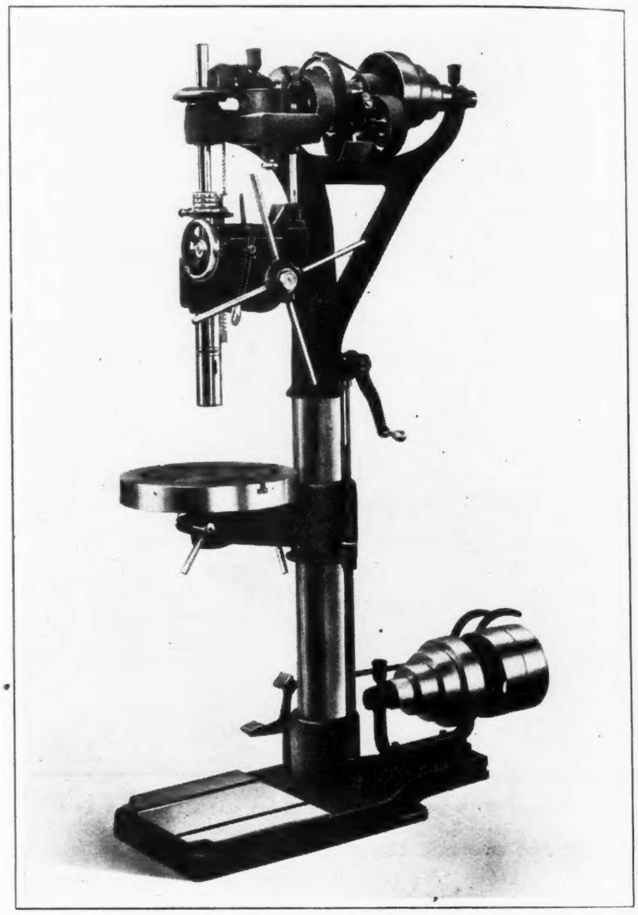
The motor is of the squirrel-cage induction type, fully enclosed, and equipped with "Norma" bearings. The standard wheels are 10 by 1 inch, and run at a speed of 1800 revolutions per minute; however, wheels of different widths and grades can be furnished when specified. The welded guards and rests are attached to the motor frame by four nuts, which are screwed on stud extensions. This grinder is ordinarily supplied for 220-, 440-, or 550-volt, two- or three-phase, 60-cycle current, but for cases where 60-cycle current is not available, a special model is furnished.



Forbes & Myers Tool Grinder equipped with Welded Guards and Rests

SUPERIOR VERTICAL-SPINDLE DRILLING MACHINE

The 20-inch drilling machine made by the Superior Machine Tool Co., Kokomo, Ind., has been redesigned to adapt it for light manufacturing work, and for use in vocational training schools, garages, etc. This machine is made in six styles, the type B-1, shown in the illustration, being back-geared and provided with geared wheel and pilot feeds. The other types differ in the drive, feed, or both. All parts



Superior Redesigned Vertical-spindle Drilling Machine

of the machine are made by an interchangeable system, which enables the machine to be readily converted or re-assembled to meet requirements. Housings for the bearings are bored standard, so that worn bushings may be easily replaced and accurate alignment maintained.

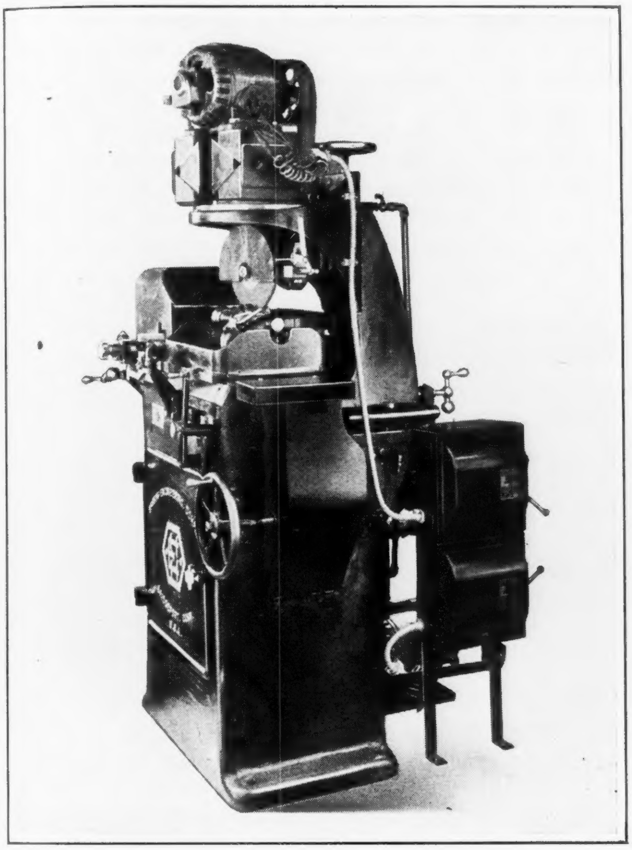
The spindle has a No. 3 Morse taper hole, and is provided with a ball thrust bearing. The drift slot for the taper hole is located in the shoulder of the spindle, where it is exposed at all times. The spindle sleeve is made of cast iron, bronze-bushed, and graduated the full length of its travel. The rack is made of steel, and secured between shoulders. The rack-pinion shaft is operated through worm-gearing, which is permanently in mesh and runs in an oil bath. The feed gears in the feed-box are made of steel and are heat-treated. The speed reduction is obtained through worm-gearing, three feeds are obtained by shifting a key in the feed-box, and three additional feeds by sliding a gear.

The base of the machine is provided with standard T-slots for securing work, and the table has a large supporting shoulder on the hub to provide additional stiffness when work is being drilled close to the edge of the table. A geared motor drive is applicable to all types of this machine, motor speeds varying from 750 to 1800 revolutions per minute being suitable. Some of the principal dimensions of the machine are as follows: Maximum distance from base to spindle, 41½ inches; maximum distance from table to

spindle, 26 inches; traverse of spindle sleeve, 8½ inches; and traverse of table, 23¼ inches. The machine drills to the center of a 20¼-inch circle, and the style illustrated weighs approximately 790 pounds.

HARRIS FULL-AUTOMATIC HOB GRINDING MACHINE

To meet the demands for a fully automatic hob grinding machine smaller than its No. 815 machine, the Harris Engineering Co., Bridgeport, Conn., has developed the No. 415



Harris Automatic Hob Grinding Machine for Hobs up to 4 Inches in Diameter by 5 Inches Long

machine here illustrated. Its rated capacity is for hobs up to 4 inches in diameter by 5 inches long, although hobs somewhat larger can be accommodated, especially if the teeth are fine. The machine will grind straight-fluted and either right- or left-hand spiral-fluted hobs, indexing automatically and feeding the hob rotatively against the wheel by means of an automatic mechanism. This mechanism is so designed that it does not require setting for different numbers of flutes in the hobs, being controlled by each complete revolution of the hob-spindle.

The grinding wheel is driven from an overhead motor through an endless open belt. By means of an overhead turntable, which is graduated in degrees to suit hobs having spiral flutes, the wheel-head is swiveled with the wheel, when the angular position of the latter is changed. Vertical adjustment of the wheel-head is obtained by revolving a handwheel at the top of the column, and lateral adjustment of the wheel is obtained by turning a ball-crank handle. The wheel-head is equipped with a truing diamond, and all moving parts are amply lubricated by means of oil wells, cups, and tubes. As much as 2 inches of belt slack may be taken up by means of adjustable wedge blocks beneath the motor.

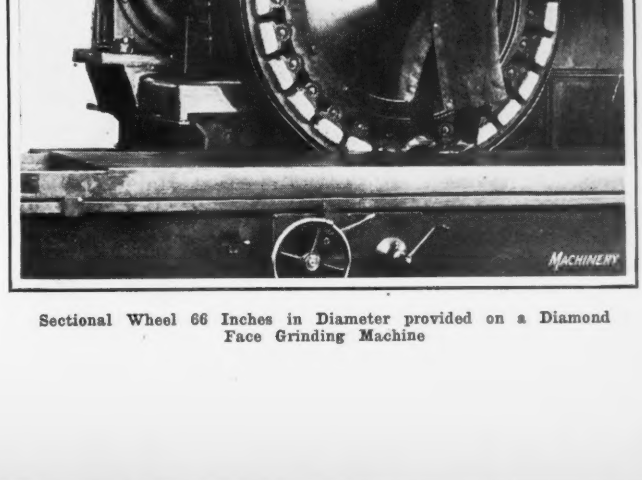
The table reversing spiral, generating, indexing, and hob-feeding mechanisms are driven automatically by a motor mounted on brackets at the rear of the base. The same motor drives the pump through an open belt. Enclosed safety-type starting switches for the motors are located at the back of the machine where they do not interfere with the attendant or the operation of the machine. A safety device is also provided to prevent damage to the mechanisms in case of accident. This machine is also furnished with a belt drive; however, the motor-driven type is recommended if a machine practically free from vibration is desired.

DIAMOND FACE GRINDING MACHINE

What is believed to be the largest grinding wheel ever provided on a face grinding machine was furnished on a machine of this class recently built by the Diamond Machine Co., Providence, R. I., for grinding large work, such as boiler sections having a height of 60 inches. An idea of the wheel dimensions may be obtained from the illustration. The wheel has an outside diameter of 66 inches, and is composed of twenty-eight separate blocks having a face width of 2 inches and a depth of 7¼ inches. Each block is held rigidly in a chuck of special design which allows the use of about 90 per cent of the abrasive material in the block before it becomes necessary to replace it. A wheel dresser built on the machine may be used while an operation is in process, without interfering with production.

The construction of the machine itself is similar to a heavy-duty face grinding machine introduced to the trade by the Diamond Machine Co., three years ago, and described in August, 1920, MACHINERY. The drive is obtained from a 75-horsepower motor which delivers power to the grinding wheel through sprockets and a silent chain. The speed of the wheel-spindle is 180 revolutions per minute. A large cutting power is available at the wheel face, due not only to the power delivered from the motor, but also to the kinetic energy stored in the rotating wheel, chuck, and spindle. The wheel-spindle is provided with bearings to reduce friction in rotation and to take up end thrust.

An automatic system provides for pumping cutting solution or water from a 140-gallon tank at the rear of the machine, collecting it after the solution flows from the wheel, and settling out the solid material before the solution is again circulated. The solution is delivered to the wheel through two nozzles by means of which the supply may be conveniently regulated. Sheet-metal guards prevent splashing of the solution and protect the bearings of the machine. The table platen measures 36 by 110 inches, and has a speed of 22 feet per minute. It is provided with slots for attaching the work and fixture. The table motion may be controlled from the front of the machine and also from the position

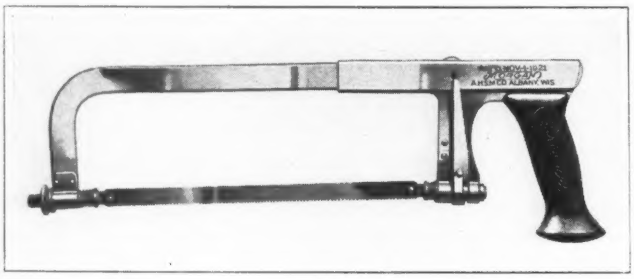


Sectional Wheel 66 Inches in Diameter provided on a Diamond Face Grinding Machine

of the operator behind the table. A patented arrangement of belts and pulleys within the bed practically eliminates shocks when the table movement is reversed. The weight of this machine is over 40,000 pounds.

MORGAN HACKSAW FRAME

Among the features claimed for the Morgan hacksaw frame, which has been placed on the market by the Albany Hardware Specialty Mfg. Co., Albany, Wis., are a means for



Morgan Hacksaw Frame of Improved Design

quickly releasing and tightening the blades; quick adjustment to suit various lengths of blades; and a quick method of setting the blades in any of four positions. The lever on the side of the frame just in front of the handle is attached to a cam, which releases the tension on the saw blade when the lever is pulled away from the frame. The frame is held in the desired position for a given blade by means of a spring stop-pin, which is seen in the illustration projecting through a hole just above the tension lever.

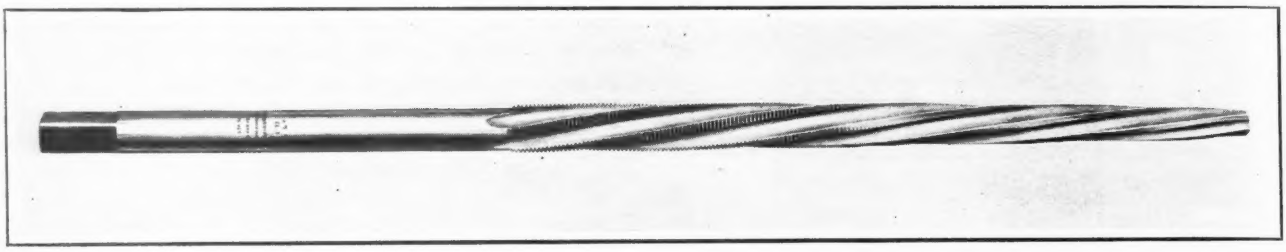
Adjustment of the tension on the blade is accomplished by means of the knurled thumb-nut at the left-hand end, the spring on the adjusting bolt doing away with the necessity of using a check-nut. In setting the blade at right angles to the frame, it is only necessary to push back a pin which holds the blade in position and then turn the blade until the spring again seats locating keys. The handle is made of hard rubber.

BRUBAKER SPIRAL-FLUTED STAYBOLT TAP

In tapping staybolt holes it is important to use taps that are not only free-cutting, but also designed to distribute the work of cutting properly in order to obtain clean threads, eliminate vibration, and consume a minimum amount of power in driving. The patented spiral-fluted staybolt tap recently introduced on the market by W. L. Brubaker & Bros. Co., Millersburg, Pa., is designed to meet these requirements. After developing this tap, tests were run for over three years in leading shops, the object being to determine whether or not the tap was a success under working conditions. According to these extensive tests, the tap has six distinct features that make it superior to any tap previously manufactured by this company.

In the first place, the taper, which varies for each size, is such that it insures a uniform distribution of the work along the entire length of the tap. The tests showed that this resulted in an average increased life of about 20 per cent. Another advantage claimed for this tap is the elimination of practically all vibration, which is usually the direct cause of tap breakage. The smoothness of operation at high speeds permits a reduction in tapping time, and consequently the production of more tapped holes per day per man. On account of the fact that the tap has a free cutting edge, it has been found possible to run the driving motor at unusually high speeds without injuring the tap. Difficulties have been experienced with some staybolt taps because of excessive friction causing the tap to soften and become dull in the heated spots, the dulling action continuing until the tool was practically ruined.

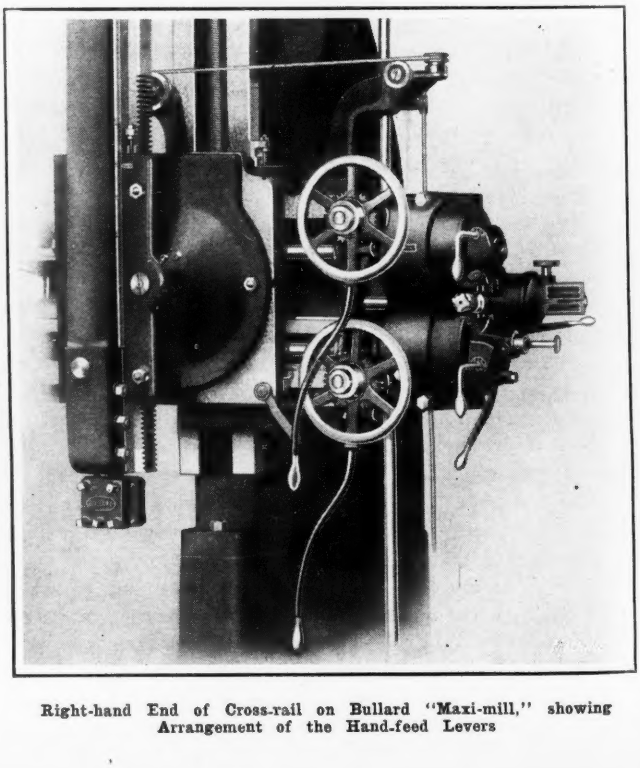
Considerable experimenting in relieving the tap was resorted to in order to eliminate chatter and obtain a method of relieving all taps uniformly; finally, it was decided that a "compound relief" was the most satisfactory. This was produced by machine relieving in conjunction with a special machining operation. To insure durability, a steel of special analysis is used in making the tap. In order to insure that the tap would be within the specified lead tolerance after the various machining operations it was found advisable to give it a special temper. With the tempering process employed the lead variation is within close limits, and at the same time the tap is given a soft center, thus combining toughness with good cutting qualities. This staybolt tap is made in all styles and sizes required in boiler building and repairing.



Brubaker Patented Spiral-fluted Staybolt Tap

HAND-FEED LEVERS ON BULLARD "MAXI-MILL"

There are many classes of work handled on turning and boring mills, for which it is desirable from the viewpoint of both quality and quantity production, to feed the tool



Right-hand End of Cross-rail on Bullard "Maxi-mill," showing Arrangement of the Hand-feed Levers

by hand in taking heavy cuts. A job of this kind is the machining of automobile tire molds. In this work, it is standard practice to feed the tool by hand in roughing out the form. In order to facilitate hand-feeding of the tools, the Bullard Machine Tool Co., Bridgeport, Conn., has equipped its "Maxi-Mill" with special levers, as here illustrated. When using these hand-feed levers, the operator stands in a position from which he can closely observe the cut, and the greater leverage obtained through their use is of considerable advantage in holding the tool in contact with the work when cutting through tough scale and into chilled cast iron or cast steel. When a form templet and pointer attached to the tool-slide are used, the operator can watch them closely, and guide the tool with ease and accuracy by the use of the levers.

These hand-feed levers are provided at both ends of the cross-rail. They are pivoted on a free swinging collar, mounted on the "hammer" handwheel supporting bracket. Hardened steel clutch teeth on the hub of the handwheel and on the hand-lever are engaged by imparting a slight forward movement to the lever. A safety device provides for automatically disengaging the levers when they are not actually held in engagement.

* * *

NEW MACHINERY AND TOOLS NOTES

Stainless Steel Rule: Brown & Sharpe Mfg. Co., Providence, R. I. A new 12-inch stainless steel rule, known as style No. 350, which is similar to the 6-inch rule described in March MACHINERY. The rule is rustproof, and will not stain or discolor. It is made of high-grade stainless steel, and is hardened and tempered. These rules are graduated in eighths, sixteenths, thirty-seconds and sixty-fourths of an inch.

Open-side Crank Planer: Whipp Machine Tool Co., Sidney, Ohio. A redesigned and improved crank shaper of the open-side type, suitable for work requiring either a planer or a shaper and hence especially adaptable to tool-rooms and vocational training schools where the installation of both a shaper and a planer is not warranted. The table stroke is adjustable by means of the shaper-type stroke-adjusting mechanism. The table drive is through a heavy crank operated by a bull wheel. The crank-arm is mounted on a bearing pin at the bottom of the bed, and its upper end and the table-adjusting nut are connected through heavy links. The table may be operated at from 7 to 70 strokes per minute. The feed-control mechanism is like that used on planers. This machine weighs about 4600 pounds.

Spot-welding Machine: Thompson Spot Welder Co., 161 Pleasant St., Lynn, Mass. A power-driven automatic spot-welding machine for such work as disk wheels and crank-cases. Its normal capacity is for welding two 3/16-inch iron or steel plates. A maximum pressure of 2000 pounds per square inch is delivered on the die points. The machine is provided with means of elevating the upper welding head or electrodes 1¾ inches, to facilitate the insertion or removal of work having flanges, ribs, etc. The machine may be operated in cycles of one spot or continuously. Automatic make-and-break switches can be set to suit the gage of stock to be welded or the amount of indentation desired. The driving pulley runs at a normal speed of about 100 revolutions per minute, which operates the machine at the rate of 20 spots per minute.

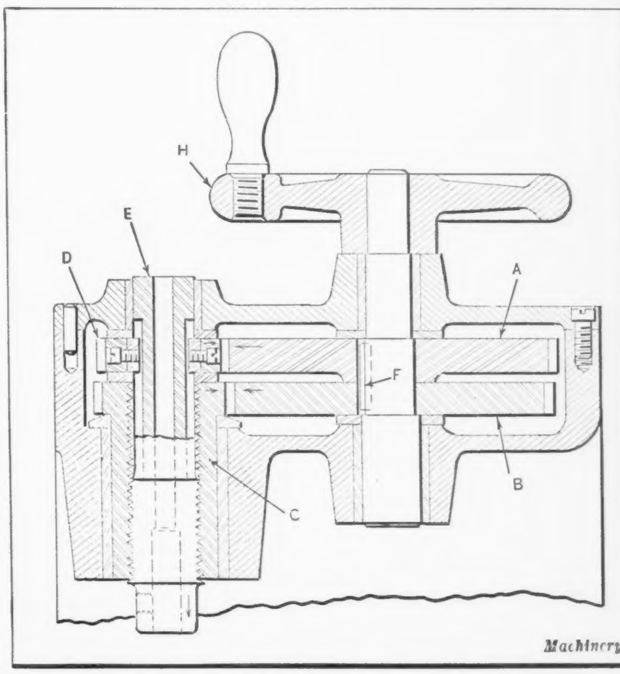
Assembling and Straightening Press: General Mfg. Co., 255 Meldrum Ave., Detroit, Mich. A power-driven assembling and straightening press, capable of exerting pressures varying from a few pounds up to twenty tons, which is intended for use as a single-purpose heavy-duty machine. This press is of the three-post type, and has a maximum ram stroke of 12 inches. The ram is driven at a constant speed in one direction through worm-gearing and spline keys. A nut revolves with the ram until pressure is applied on a foot-pedal, to tighten a brake and stop the nut. The ram then advances through the nut until the pressure is released from the foot-pedal, at which time a spring connected by a cable to the top of the ram returns it to the raised position. The maximum height between the table and the ram nose on the standard machine is 18 inches, but this dimension may be changed to meet requirements.

* * *

HAND-OPERATED BORING TOOL

A certain automobile repair part, which is regularly sent out with a nominal sized hole, must, on account of the particularly close limits required, be bored at the service station during the assembling operation. As many service stations are not equipped with machine tools adapted for this work, a special fixture (the driving mechanism of which is shown in the accompanying illustration) was designed for their use. The fixture holds the part securely, and drives a small piloted boring tool through the hole at an extremely fine rate of feed.

The operation is merely to set up the part (not shown), insert the boring-bar, and turn the handwheel *H*. It will be noted that two gears are mounted on the handwheel

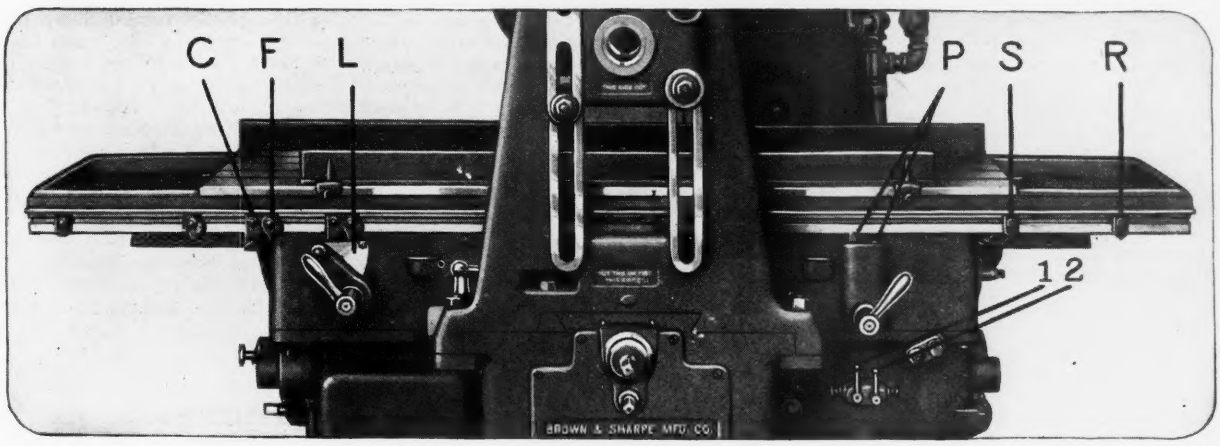


Hand-operated Boring Tool used in assembling Automobile Repair Part

shaft, and held in place by a key *F*. Gear *A* has 80 teeth of 16 pitch, and gear *B* has 79 teeth of 16 pitch. gear *A* drives gear *D*, which has 30 teeth, turning it in the direction indicated by the arrow at a speed ratio of 8 to 3 or 2.666. Also gear *B* turns gear *C*, the ratio between these gears being 2.548. Gear *C* will therefore make 0.882 revolution while *D* is making one revolution.

Gear *D* is provided with two splines which are a sliding fit in keyways cut in spindle *E*. A 16-pitch thread is cut the entire length of the hole through gear *C*. Now as the splines drive spindle *E* at a different speed from that of the threaded gear *C*, the resultant action will be a feeding movement of shaft *E* in a downward direction. The amount of feed per revolution of the spindle is found by multiplying the differential ratio by the exact pitch of the thread in gear *C*. In this case, the tool feed for each revolution of the spindle or boring-bar would be equal to 0.118 × 0.0625 or about 0.0073 inch. The boring-bar makes about 2 2/3 revolutions for each complete revolution of the handwheel. The feed per revolution of the handwheel is about 0.019 inch. The holes bored by the use of this attachment are accurate and free from tool marks. W. R.

SHARPE Automatic Milling Machine



Dogs control all movements of Table and Spindle

All the automatic controls of this machine are operated by four styles of table dogs.

Dogs "C" and "F" acting on gear sector "L" control the Constant Fast Travel and Variable Cutting Feed of the table, respectively, and may be set to act in either direction.

Dogs "R" and "S" acting on plungers "P" control the reversing and stopping of the table. These dogs in conjunction with levers "1" and "2" may be set to secure continuous, intermittent or semi-automatic milling.

The Spindle can be set to start, stop or reverse automatically or it can be set to run continuously in either direction. The Spindle reverse is controlled by dogs similar to "C" and "F" placed on the rear of the table at the right.

When working in conjunction with the table, the Spindle starts whenever the variable cutting feed is engaged and stops whenever the table stops, reverses or moves at its constant fast travel.

Write for Specifications.

BROWN & SHARPE MFG. CO.

Providence, R.I., U.S.A.

PERSONALS

Fred C. Stiening, formerly chief engineer of the Thomas Spacing Machine Co., Pittsburg, Pa., is no longer connected with that concern. Mr. Stiening's plans for the future have not yet been announced.

Fred E. Lampe, until recently associated with the Powers Accounting Machine Corporation, has become connected with the Wales Adding Machine Co., Wilkes-Barre, Pa., in the capacity of production engineer.

Albert Schaffner, formerly with the United States Navy Yard at Philadelphia, has become associated with the H. B. Underwood Corporation, 1015 Hamilton St., Philadelphia, Pa., manufacturer of portable tools for industrial plants, marine shops, and railroad shops.

E. H. Rhynearson, for five years with the Millholland Machine Co., Indianapolis, Ind., and also for five years with the E. A. Kinsey Co., machinery dealer, Cincinnati, Ohio, has been placed in charge of the used machinery department of the Vonnegut Machinery Co., of Indianapolis, Ind.

R. L. Morgan, of the Greenfield Tap & Die Corporation, Greenfield, Mass., will terminate his connection with that concern on June 1. Mr. Morgan developed the "Hydroil" internal grinder manufactured by the company. His address after June 1 will be 393 Main St., Worcester, Mass.

Louis W. Williams, who has been in charge of the New York office and warehouse of the Union Drawn Steel Co., Beaver Falls, Pa., serving in the capacity of eastern sales agent, has been succeeded by J. P. Barnum, late assistant sales agent, and for many years office manager at New York.

W. H. Marshall, chairman of the board of the Consolidated Machine Tool Corporation of America, builder of machine tools, railroad and shipyard equipment, 17 E. 42nd St., New York City, has been elected president of the company to fill the vacancy caused by the sudden death of C. K. Lassiter on March 3.

Arthur H. Adams, consulting engineer, of 41 Park Row, New York City, specializing on design, development, and production problems in light and especially delicate mechanical and electro-mechanical devices, has recently become assistant to the superintendent of development of the Hawthorne, Ill., works of the Western Electric Co., Inc.

L. B. Augustine has been appointed export sales manager of the Wisconsin Electric Co. with offices at the factory in Racine, Wis. The company is undertaking a vigorous campaign to develop its export business in "Dumore" toolpost grinders, drills, motors, and electrical appliances. H. A. Schultz has been appointed advertising manager of the company.

John C. Cotter, formerly with the J. H. Williams & Co., at Buffalo, N. Y., has become associated with the Western Drop Forge Co., Marion, Ind. Mr. Cotter was connected with J. H. Williams & Co. for a number of years, having served as works manager of the Brooklyn factory, Buffalo district sales manager, and general sales manager of the special forgings department.

H. E. Witham has been appointed manager of the Chicago office of the Kearney & Trecker Corporation, Milwaukee, Wis., to take the place of W. H. Allen who has been promoted to the position of sales manager. Mr. Witham was previously connected with the Warner & Swasey Co., Cleveland, Ohio, serving in various capacities, principally with the sales department, and eventually being placed in charge of the Chicago office.

S. P. Rockwell, 65 Highland St., Hartford, Conn., was appointed by the American Gear Manufacturers' Association at its seventh annual convention, held in Cleveland, April 19 to 21, consulting metallurgist of the association. In this capacity, any of the members of the association may call on Mr. Rockwell for consulting work, when any problems arise in which they may be aided by Mr. Rockwell's experience in the metallurgical and heat-treating field.

W. H. Allen has been promoted to the position of sales manager of the Kearney & Trecker Corporation, Milwaukee, Wis., and will assume his new duties in that capacity at once. From 1906 to 1915 he was employed as a salesman for the Charles H. Besly Co., of Chicago, and subsequently became Chicago sales representative of the Fellows Gear Shaper Co. In 1918 he associated himself with the Kearney & Trecker Corporation in the capacity of manager of the Chicago office, which position he has held up to the present time.

Clifford F. Messinger, for the last three years general sales manager of the Chain Belt Co., Milwaukee, Wis., manufacturer of "Rex" conveying and transmission chains, concrete mixers, conveying machinery, and traveling water screens, has been elected second vice-president. Mr. Messinger entered the employ of the Chain Belt Co. in 1911, and has held the positions of advertising manager, manager of concrete mixer sales, and general sales manager. He is also a director of the Chain Belt Co., and a director of the Interstate Drop Forge Co. of Milwaukee.

Reginald Clark has become associated with the Western Drop Forge Co., Marion, Ind. Mr. Clark sailed for England on March 24, to investigate foreign forge practices in the interest of the company, and upon his return to the United States will reside and take up his work in Marion. He was previously connected with J. H. Williams & Co., and for many years with the Rolls-Royce Co. in Derby, England. During the war he was sent by the latter company to the United States to supervise the production, testing, and all elements in connection with forgings used in the Rolls-Royce battle plane motor.

Henry Dreses, president and general manager of the Dreses Machine Tool Co., who recently retired from active business, after fifty-four years' service in the machine tool industry, was tendered a farewell dinner by the radial drilling machine manufacturers of Cincinnati on the evening of April 4 at the Business Men's Club. August H. Tuechter acted as toastmaster, and presented Mr. Dreses, on behalf of his former associates, with a beautiful Rookwood vase, as an expression of their respect and esteem. The following were present: J. B. Doan, American Tool Works Co.; J. C. Carlton Machine Tool Co.; Oscar W. Mueller, Mueller Machine Tool Co.; Norman B. Chace, Fosdick Machine Tool Co.; George M. Morris and Arthur C. Pletz, Morris Machine Tool Co.; William Gilbert, Charles Gilbert and Walter Hudson, Dreses Machine Tool Co.; George P. Gradolf and August H. Tuechter, Cincinnati Bickford Tool Co.

* * *

THE AMERICAN MANAGEMENT ASSOCIATION

The American Management Association was formed at a recent meeting in New York City, at which were present nearly 200 executives representing industrial and commercial enterprises in various parts of the country. The new organization takes the place of the National Personnel Association, and will be devoted exclusively to the consideration of the human factor in commerce and industry. The association recognizes that personnel work is an inseparable part of management, and is interwoven in all the efforts and activities of the production and sales departments. It cannot be segregated as an isolated function, and must be dealt with by management with the same care as production and sales problems. The human factor in industry must be handled in a more intelligent manner than it has in the past, if the best results as regards industrial harmony and cooperation are to be obtained. Among the men at the meeting who expressed themselves strongly along these lines was Charles R. Hook of Middletown, Ohio, vice-president and general manager of the American Rolling Mill Co., who declared that the leaders of American industry must carry to the rank and file of the workers a clear and simple explanation of the problems of business as they relate to the particular work in which any one industrial enterprise is engaged.

* * *

THE INDUSTRIAL OUTLOOK

As summarized by W. F. Gephart, vice-president of the First National Bank of St. Louis, the outstanding factors in the industrial situation today are as follows:

The present tendency of business is upward, but further increases above the existing physical volume of trade are handicapped by the lack of adequate transportation facilities.

The upward movement of prices may continue in the case of some classes of commodities, but there will probably be a marked resistance to too rapid and too great advances in the case of consumers' goods. One of the unfortunate effects of the transportation situation is that it may produce a temporary "place scarcity" of some commodities, with the result that some unhealthy price advances may occur.

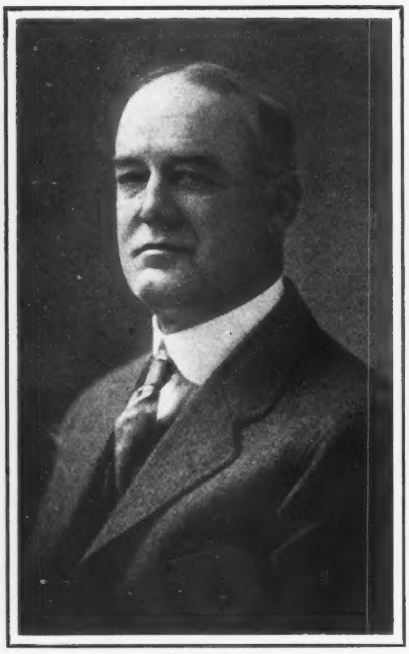
Wages, like prices, will probably reach higher levels in some lines of business. This, coupled with higher raw material costs, in the face of a resisting market, will probably tend to restrict industrial profits, even though business activity continues at a relatively high level.

While the Federal Government has been making some progress in reducing expenses, there is no sound basis for assuming that any material reduction in taxes can be expected in the near future. As a matter of fact, if some of the plans that are now under consideration are put into force, taxes may tend higher rather than lower.

OBITUARIES

WINSLOW BLANCHARD

Winslow Blanchard, president of The Blanchard Machine Co. of Cambridge, Mass., and widely known in the machine tool industry, died at his home in Waban, Mass., April 7, after an illness of some months. He was born in Dorchester, Mass., September 24, 1865, the son of John W. and Harriet Blanchard. A graduate of the Institute of Technology in the class of 1888, in his early professional life he served on the engineering staffs of the Boston Heating Co., and the Metropolitan Sewerage Commission, but for more than twenty years had been associated with The Blanchard Machine Co., of which he was the head. Mr. Blanchard held all the chief executive offices of the Boston Branch of the National Metal Trades Association, and was treasurer of the Associated Industries of Massachusetts, first vice-president of the National Machine Tool Builders' Association, one of the Board of Governors of the Massachusetts Charitable Mechanics' Association, a member of the Employers' Association of Eastern Massachusetts, the Engineers' Club of Boston, the Machinery Club of New York, the Wellesley Country Club and the Waban Neighborhood Club.



Mr. Blanchard was responsible for bringing out a line of grinding machines so original in design that the type was generally referred to as Blanchard grinders. These machines have greatly widened the field for the grinding of flat surfaces and many parts that formerly it was not considered practicable to grind.

Mr. Blanchard is survived by his wife, two brothers and a sister.

Fred S. Martin, staff superintendent of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., died recently in the West Penn Hospital, Pittsburg, following an operation. Mr. Martin was born in Claverick, N. Y., February 12, 1863. He graduated from the Staustead Wesleyan College, Staustead, Canada, in 1878, with a commercial degree. After completing his college education, he took up the machinist trade at the Franklin Foundry & Machine Co., Providence, R. I. Upon completing his training, he became superintendent of the Brown & Sharpe Mfg. Co., which position he held for eight years. Later he became foreman of the Edison General Electric Co. in Schenectady, and in November, 1906, entered the employ of the R. D. Nuttall Co., Pittsburg. Subsequently he was employed by the Westinghouse Electric & Mfg. Co., and served as superintendent of the large industrial motor department for a period of eleven years. In 1918 he was appointed staff superintendent and held that position until the time of his death. He was a member of the American Society of Mechanical Engineers. Mr. Martin is survived by his wife, three sons, and one daughter.

Frederick M. Stevens, for the last twelve years production manager of John Chatillon & Sons, died in New York City on April 8, in his seventy-second year. Mr. Stevens was born in Danbury, Conn., and after finishing public school, attended the Gloversville Military Academy. He then entered Cornell University, where he studied mechanical engineering. After completing his education, he spent fourteen years in production work with Mathews & Willard, of Waterbury, Conn. He left Waterbury to take charge of the production of the Manhattan Screw & Stamping Co. in New York City. During the last twelve years of his life, Mr. Stevens served as production manager of John Chatillon & Sons. During this time he made many notable changes in production methods and practice, developing and improving many types of scales and cutlery. Mr. Stevens is survived by a widow and three daughters.

Walter H. Gilliland, architect for the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., died on April 1 at his residence in Pittsburg, aged fifty years. Mr. Gilliland became connected with the Westinghouse company in 1904. At the time of his death he held the position of works architect, and had charge of the designing of buildings for the company not only at East Pittsburg but throughout the United States. He is survived by his wife, a daughter, and two sons.

Ernest Mills, vice-president and production manager of the Smith & Mills Co., Cincinnati, Ohio, manufacturer of shapers, died at his home in Cincinnati on April 4, after an illness of about three months. Mr. Mills was forty-nine years old at the time of his death, and had spent thirty-five years in the business. He leaves a widow, one son, two daughters and a brother, James Mills, who is president of the Smith & Mills Co. He was a Scottish Rite mason.

M. C. Townley, president of the Walcott Lathe Co., Jackson, Mich., died on April 3.

MEETING OF AMERICAN WELDING SOCIETY

The annual meeting of the American Welding Society was held in the Engineering Societies' Building, 29 W. 39th St., New York City, April 24 to 27. The first day was devoted to committee meetings on the training of operators, resistance welding, electric arc welding, and the welding of storage tanks. The committee on specifications for steel to be welded, met Thursday, April 26, and in the evening of the same day the technical session of the society was held, when papers were read on "Welding of Unfired Pressure Vessels," by H. L. Whittemore, and on "Training of Welding Operators," by J. C. Wright. During the last day of the meeting the gas welding committee outlined plans for future activities.

The committee on training of operators outlined courses for training both gas and electric welders; the resistance welding committee considered a research program and assigned specific problems to appropriate laboratories and individuals. The electric arc welding committee dealt with standardization of arc welding apparatus, cast iron welding, applications of arc welding to ship construction, and welding of non-ferrous metals and manganese steel. Recent developments in the electric arc welding field were reviewed. The committee on specifications for steel to be welded made plans for such investigations as are necessary to enable the committee to draw up specifications for steel.

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SWISS FIRM RECEIVES FRANKLIN INSTITUTE MEDAL

The Franklin Institute, Philadelphia, Pa., at its meeting Wednesday, April 18, conferred the Edward Longstreth medal upon the Societe Genevoise d'Instruments de Physique of Geneva, Switzerland, for that company's universal measuring machine. R. Y. Ferner, of 1410 H St., N. W., Washington, D. C., the American representative of the company, received the medal on behalf of the Geneva firm. This medal is awarded for unusual developments and inventions pertaining to mechanical processes. The universal measuring machine, for which the medal was awarded, is a machine adapted to the measurement of gages of all types used in machine shops for inspection or working purposes, including plug, disk, plate, snap, ring, and thread gages.

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The British Engineering Standards Association has recently published a conveniently arranged glossary of the terms employed in aeronautical work. The glossary is divided into sections covering general aeronautics, airplanes, airships, aircraft engines, and instruments. In each section the terms employed are logically arranged and clearly defined. Illustrations are given in many cases to assist the user, and a complete general index is also included, so that any particular term can be readily located. The number of the publication is 185—1239, and it is obtainable from the offices of the association at 28 Victoria St., London, S. W. 1, price 1s 5d.

TRADE NOTES

Bridgeport Brass Co., Bridgeport, Conn., has moved its Chicago district sales office from the State Lake Building to the Wrigley Building.

American Grinding Co., Philadelphia, Pa., is erecting a new building at 1527 Fairmount Ave. The company plans to increase its range of work and will install some additional special machinery.

LaPorte Machine & Tool Co., Inc., LaPorte, Ind., has acquired the manufacturing rights to the J. & B. filing and sawing machine formerly built by the Johnson & Biddle Tool Co., Elkhart, Ind.

Williams, White & Co., Moline, Ill., have opened an office at 623-625 Majestic Bldg., Detroit, Mich., for the accommodation of their customers in that territory. C. G. d'Ugglas is in charge of the new office.

John Steptoe Co., Cincinnati, Ohio, manufacturer of shapers, milling machines, and lathes, has made arrangements to build the die-slotting machine previously made by the Peters-Bossert Co., which was described in February, 1922, Machinery.

Peter A. Frasse & Co., Inc., 417 Canal St., New York City, have purchased the entire stock of seamless steel tubes of the U. T. Hungerford Brass & Copper Co., New York, the latter company having discontinued the handling and sale of seamless steel tubes.

Cutler-Hammer Mfg. Co., Milwaukee, Wis., has made an agency arrangement with O. T. Jenkins, 1002 Pacific Ave., Dallas, Tex., for the sale of wiring devices, radio apparatus, and standard industrial heating apparatus. The territory covered is Texas and Oklahoma.

Oilgear Co., Milwaukee, Wis., manufacturer of hydraulic presses, broaching machines, variable delivery pumps, and variable-speed drives, has appointed the Cleveland Duplex Machinery Co. Inc., 1224 W. 6th St., Cleveland, Ohio, as its representative in the northern Ohio district.

Rockford Milling Machine Co., Rockford, Ill., has appointed Manning Maxwell & Moore, Inc., its exclusive representative in the Atlanta, Ga., territory with offices at Atlanta. The company will represent the Rockford Tool Co., as well as the Rockford Milling Machine Co.

Triplex Machine Tool Corporation, 50 Church St., New York City, has appointed the firm of Neff, Kohlbusch & Bissell, 1045 W. Washington Blvd., Chicago, Ill., exclusive agent for the sale of the Triplex combination bench lathe, milling and drilling machine in the Chicago territory.

Walter A. Zelnicker Supply Co., St. Louis, Mo., has moved from 325 Locust St., where it has been located for the last twenty years, to new offices in the Chamber of Commerce Bldg., 511 Locust St. The main plant and yards of the company in East St. Louis now cover fourteen acres.

Rockford Machine Tool Co., Rockford, Ill., has given the following dealers exclusive sales rights in their respective territories for Rockford planers, shapers, and drilling machines: C. A. Thumm, 125 Light St., Baltimore, Md.; Milwaukee Machinery Co., 93 W. Water St., Milwaukee, Wis.

Cutler-Hammer Mfg. Co., Milwaukee, Wis., moved its Pittsburg office on May 1 from the Farmers Bank Building to Rooms 950-953 Century Building, located on Seventh St., between Penn Ave. and Duquesne Way. A. G. Pierce is manager of the central district with headquarters in Pittsburg.

Camden Mfg. Co., Camden, N. J., has been taken over by William T. J. Purnell, president of the Palmyra National Bank, and Jacob M. Noll, formerly general manager of the Nelson Valve Co. The company will be known as the Camden Die Mfg. Co., and will continue to manufacture the "Camco" dies.

Dwight P. Robinson & Co., 125 E. 46th St., New York City, engineers and constructors, have opened a Philadelphia office which will be under the direction of Carl A. Baer, a consulting engineer in the design of industrial textile and power plants, recently connected with the firm of Baer, Cook & Co., engineers.

Precision & Thread Grinder Mfg. Co., 1 S. 21st St., Philadelphia, Pa., manufacturer of the multi-graduated precision grinder and precision thread lead variator, announces the following newly elected officers: President and general manager, A. T. Doud; vice-president and chief engineer, W. H. Frick; treasurer, F. V. Doud; and secretary, W. C. Greger.

Cleveland Abrasive Wheel Co., Cleveland, Ohio, has recently added to its plant and equipment, and is now in a position to supply vitrified and shellac wheels, as well as those manufactured by the silicate process. This company started by manufacturing only silicate wheels, but has widened its scope, so that it now meets all grinding wheel requirements.

Bickett Machine & Mfg. Co., Cincinnati, Ohio, has been reorganized and is now doing business at 650 Evans St., Cincinnati, under the name of Bickett Miller Co. The company will continue to manufacture the Bickett line of bench milling machines, and will also design and build special machinery and tools and do general contract work. C. A. Bickett is president and general manager.

Chicago Belting Co., 127 N. Green St., Chicago, Ill., has opened a direct factory branch at 66 Forsythe St., Atlanta, Ga. The new branch will be under the management of Ben L. Willingham and Brad Hodges, both of whom have had broad experience in the belting field. At the new branch the company will carry a complete stock of "Reliance" and "Sea Lion" leather belting, as well as a complete line of belting accessories.

Griswold Mfg. Co., Rock Island, Ill., has sold its entire assets to C. P. Thomas, of Rock Island, and the business will be operated in the future under the firm name of the Thomas-Kerns Co. (not incorporated). The Thomas-Kerns Co. is entering the light metal specialty engineering field, and in addition to stampings, will produce jigs, tools, dies, wood and metal patterns, models, etc. It will also undertake plating, enameling and spot-welding.

Midwestern Tool Co., 5215 Ravenswood Ave., Chicago, Ill., has recently been formed for the purpose of manufacturing hobs, milling cutters, jigs, fixtures, dies, gages, and special tools. S. R. Swenson, who has been chiefly active in forming the new company, will act as general manager. Mr. Swenson has had extensive experience in the field covered by the new company, having formerly been connected with the Barber-Colman Co., the Illinois Tool Works, and the Goddard Tool Co.

American Metal Products Co., Milwaukee, Wis., manufacturer of "Ampco," a copper aluminum steel alloy of high tensile strength and acid-resisting properties, reports an increase of 400 per cent in its business over the previous year. The company has just installed a Detroit electric rocking type furnace to take care of its increasing business in ingots and castings. Other new equipment is being installed, and the installation of a wire-drawing equipment is contemplated.

Combustion Engineering Corporation, Limited, and the Uehling Instrument Co., Paterson, N. J., have entered into an agreement whereby Uehling interests in Canada and Newfoundland will be handled exclusively by the Combustion Engineering Corporation, Ltd., with principal offices located in Toronto, Montreal, Winnipeg and Vancouver. The Uehling line includes CO_2 recorders, SO_2 recorders, draft recorders, combined barometer and vacuum recorders, absolute pressure indicators, etc.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., is erecting a twenty-three story bank and office building at Broadway and Liberty St., New York City, which will be known as the Westinghouse Building. All the space above the eleventh floor will be occupied by the Westinghouse Electric & Mfg. Co., Westinghouse Electric International Co., Westinghouse Lamp Co., Westinghouse Air Brake Co., and allied organizations. The building is expected to be ready for occupancy on May 1, 1924.

Marf Machine & Die Casting Co., Inc., Brooklyn, N. Y., manufacturer of die-castings in aluminum, zinc, tin, and lead alloys, has opened a New England office at 51 Harrison Ave., Room 222, Springfield, Mass., of which John C. Bennett is manager. Mr. Bennett has been secretary, and for the past year president of the Purchasing Agents' Association of western Massachusetts, and was previously connected with the Stevens-Duryea Automobile Co., the Fisk Rubber Co., and the Hampden Grinding Wheel Co.

Whitman & Barnes Co., Akron, Ohio, transferred its New York City office and warehouse on May 1 from 64 Reade St. to new and more commodious quarters at 99 Chambers St., corner of Church. This location will afford increased accommodations and facilities for the carrying of larger stocks of W & B twist drills and reamers, thereby enabling the company to render a complete service in the eastern district. Frank W. Oliver, manager in charge, with a corps of salesmen, will represent the company's interests as heretofore.

Rolled Thread Die Co., 28 Cherry St., Worcester, Mass., has been formed for the purpose of manufacturing rolled thread dies. The company has been formed by E. Howard Reed and M. Clifton Nelson, who have had extensive experience in practical thread rolling. The new company expects to embody in its method of design and manufacture of thread rolling dies some new principles discovered through an exhaustive study of the problems involved in thread rolling, and expects to place on the market dies that will produce a high grade of rolled thread.